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PRODUCTION OF ZIRCONIUM AT Y-12

By
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October 12, 1951

Carbide and Carbon Chemicals Company
Oak Ridge, Tennessee

Technical Information Service, Oak Ridge, Tennessee

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CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

Y-12 PLANT

W-7405-Eng-26

CHEMICAL DIVISION

Mr. J. M. Herndon, Superintendent

CHEMICAL DEPARTMENT

Mr. G. A. Strasser, Superintendent

PRODUCTION OF ZIRCONIUM AT Y-12

J. W. Ramsey
W. K. Whitson, Jr.

ABSTRACT

A general description is given of the permanent zirconium plant at Y-12. Equipment is described and materials of construction are listed. Photographs illustrating principal equipment and reduced construction drawings are also presented. Operating conditions and costs information are listed.

Oak Ridge, Tennessee

October 12, 1951

INTRODUCTION

Production of purified hafnium-free zirconium was begun at Y-12 in January, 1950. At the request of the Atomic Energy Commission, a quick installation of equipment was made in order to produce 25,000 pounds of zirconium as oxide for initial experiments for the Naval Reactor Program. Less than 0.1% contained hafnium was specified. At that time, a program was started on designing a more efficient plant for the production of 150,000-200,000 pounds of zirconium per year. The permanent zirconium plant was completed in October, 1951. Additions were made to the extraction facilities and equipment for continuous purification by the phthalate process and continuous drying and calcining were provided.

At the time of this writing, the permanent zirconium plant is in the start-up stage. This report describes the equipment and process as they now exist and the operational plans which have been developed from experience and from laboratory and pilot plant work.

The original proposal for the permanent zirconium plant is outlined in a report, Y-573, "Separation of Zirconium and Hafnium - Proposal for Construction and Operation of Zirconium Production Plant", J. M. Googin and G. A. Strasser, March 14, 1950. These plans have been followed to completion with but few changes. Greater length of extraction and stripping columns was installed than was first planned in order to effect more complete separation

which was later requested. Later information obtained on calcining showed that protection against contamination in this stage was more difficult than had been expected, and consequently the expense of more elaborate calcination equipment was required. Corrosion of exteriors from vapors in the processing areas was found to be a serious problem and more elaborate ventilation and protective measures were taken than had been planned in the proposal. Otherwise the original proposal has been followed through approximately as first outlined.

It is suggested that reference should be made to report Y-573 relative to studying the report presented here.

DESCRIPTION OF PROCESS

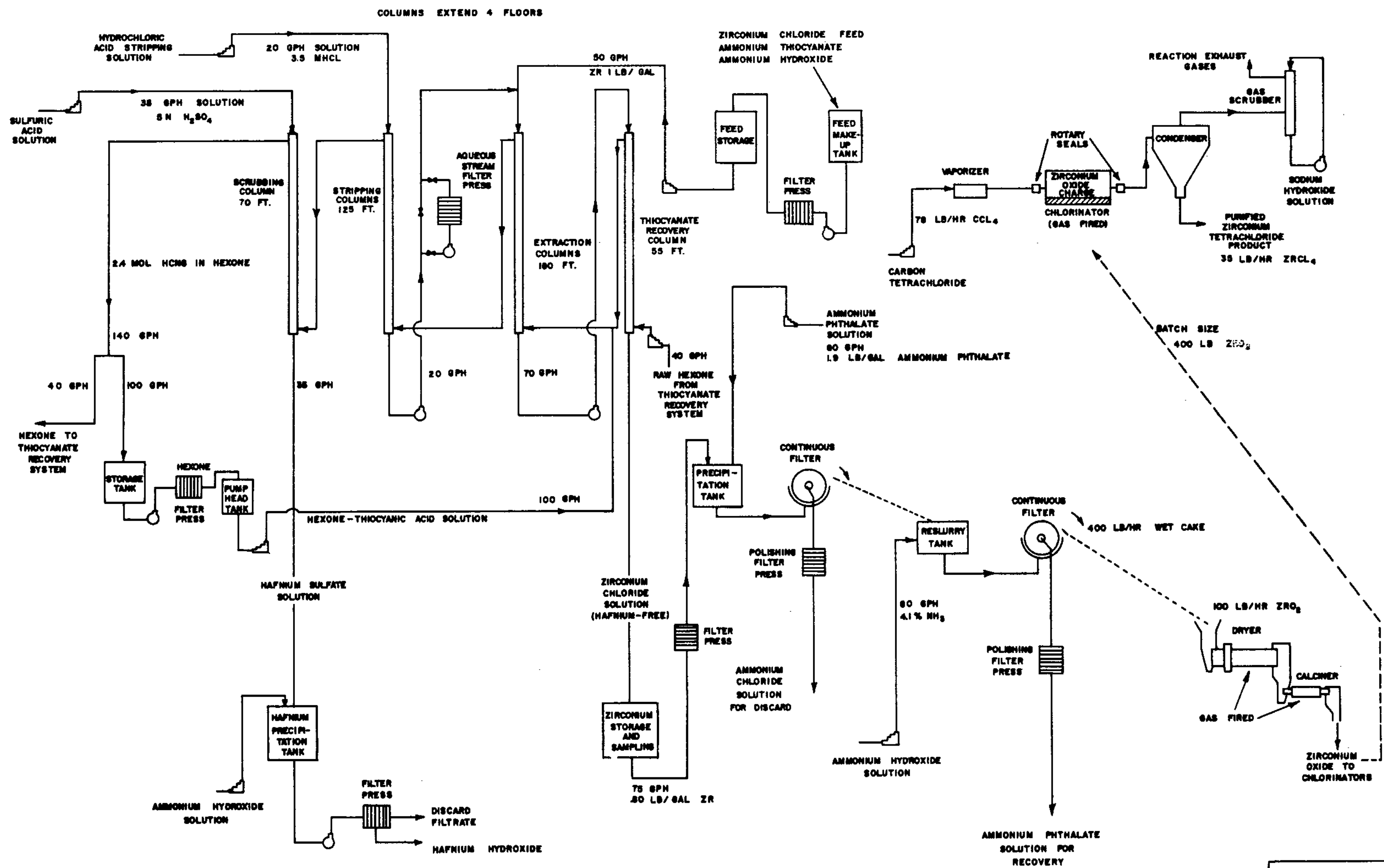
The attached flow sheet and photographs illustrate the permanent zirconium plant in Building 9211 at Y-12.

Zirconium tetrachloride, normally containing from 1.5 percent to 2.0 percent hafnium, is received from Titanium Alloy Manufacturing Division of the National Lead Company for use as feed material. Hafnium is removed from zirconium by an extraction process and resulting solutions are further purified by phthalate precipitation. Zirconium phthalate is converted to zirconium hydroxide by ammonium hydroxide leaching and the zirconium hydroxide is dried and calcined. The zirconium oxide is then chlorinated to form zirconium tetrachloride, which is used in magnesium reduction to the metal.

The steps in processing at Carbide and Carbon Chemicals Company, Y-12 Plant, are shown on the attached flow sheet and outlined as follows:

Hafnium Separation

Hafnium is separated from zirconium by a solvent extraction process employing methyl iso-butyl ketone. The separation is carried out in continuous counter-current spray towers. Solution containing normal zirconium is fed in the center of the extraction plant. The zirconium solution flows out the bottom of the plant while the hafnium is carried by the solvent to the top of the plant.



PERMANENT ZIRCONIUM PLANT
GENERAL FLOW DIAGRAM
SEPT. 20, 1961

Zirconium tetrachloride is dissolved in water (top center of flow sheet) and the required quantities of ammonium thiocyanate and ammonium hydroxide are added to form the extraction feed solution. Some of the equipment used is shown in Figure 1, "Feed Make-up and Storage Area - Tank Pit". Feed solution is pumped to the column (Figure 2, "Base of Extraction Columns-First Floor"). There are three columns for extraction, two columns for stripping, one column for scrubbing, and one column for thiocyanate recovery. Columns are controlled by operators on the third floor (Figure 3, "Extraction Control Area").

Hafnium thiocyanate is preferentially extracted into hexone-thiocyanic acid solution, which is pumped into the bottom of the extraction column. Hexone from the extraction column flows into the stripping column, counter-current to a stripping solution of dilute hydrochloric acid. Aqueous stripper solution containing stripped zirconium is fed back into the extraction column with the extraction feed solution. Stripped hexone containing very pure hafnium flows into the scrubbing column where it is scrubbed with sulfuric acid solution. This hexone, free of metal, but still containing thiocyanic acid is recirculated to the extraction columns.

For smallest useage of thiocyanate, it is desirable to have thiocyanate concentration in the product stream at a very low level. This is accomplished

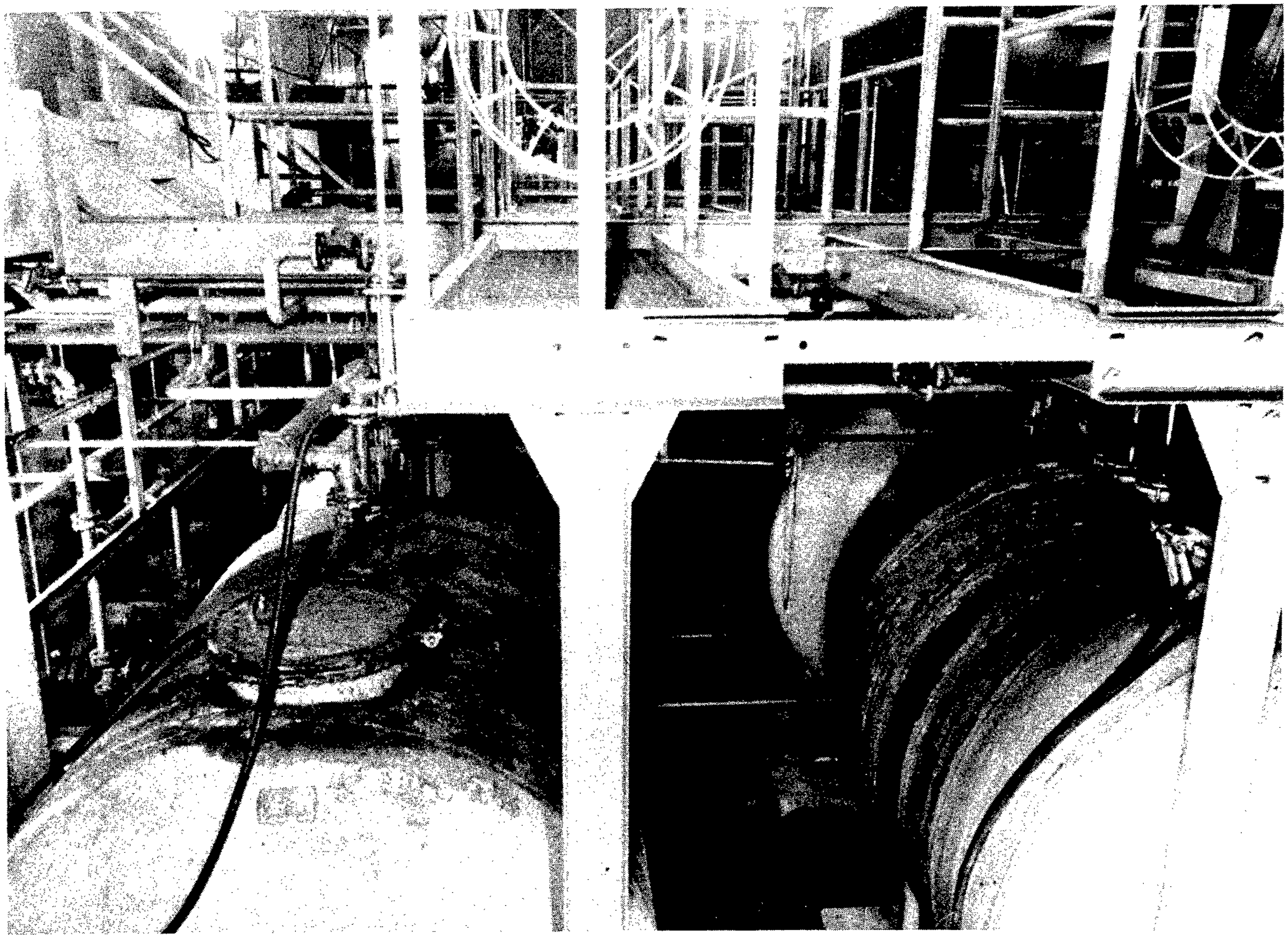


FIGURE I. FEED MAKEUP AND STORAGE AREA – TANK PIT

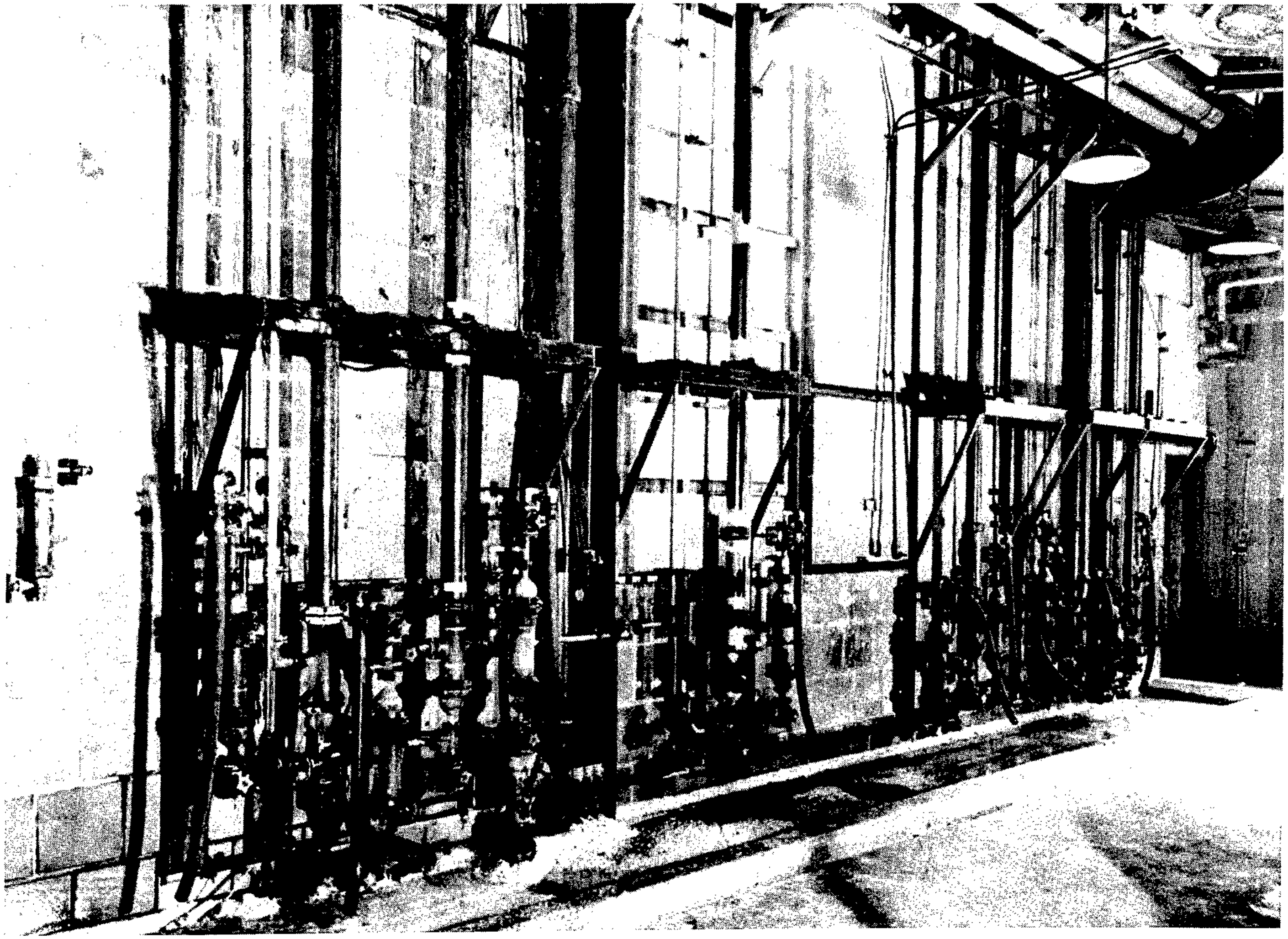


FIGURE 2. BASE OF EXTRACTION COLUMNS- FIRST FLOOR

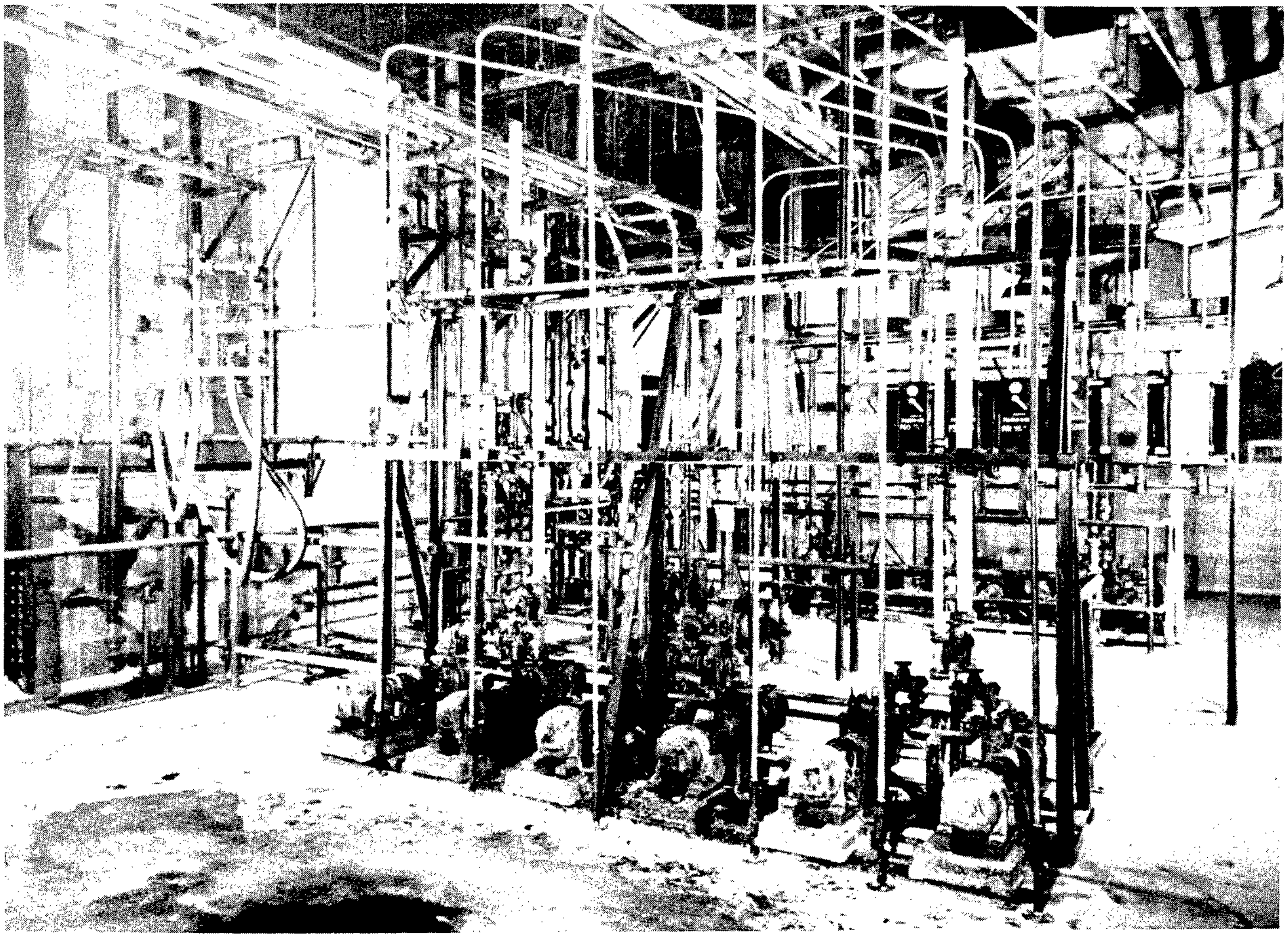


FIGURE 3. EXTRACTION CONTROL AREA – THIRD FLOOR

by directing the aqueous solution from the third extraction column into a thiocyanate recovery column. The thiocyanate recovery column is fed with raw hexone at a rate of approximately one-third the total hexone flow. Hexone from this column contains thiocyanic acid at the proper concentration for extraction and is mixed with the hexone entering the extraction columns. Raw hexone to be fed to the thiocyanate recovery column is prepared from a portion of the scrubbed hexone diverted to an ammonium neutralization system. Ammonium thiocyanate from this system is used in feed makeup.

Zirconyl chloride solution, hafnium-free, goes from the last extraction column to a tank for storage and sampling, and then to be further processed by precipitation with ammonium phthalate solution.

The hafnium is recovered from the hexone by sulfuric acid scrubbing. Hafnium is recovered from the sulfuric acid solution as hafnium hydroxide by precipitation with ammonium hydroxide.

Separation of Other Impurities

While hafnium is the element requiring special separation procedures, it is also necessary to remove other metal ions present as impurities in the feed material. This purification is carried out by precipitating zirconium as zirconyl phthalate. The phthalate precipitation is very selective for zir-

conium and hafnium, while other impurities, such as iron, copper, cadmium, etc., remain in solution and are thus separated.

In the permanent zirconium plant, ammonium phthalate solution and zirconium chloride solution are fed continuously to a precipitation tank, which, in turn, feeds a continuous Eimco filter. This equipment is shown in Figure 4, "Phthalate Precipitation Equipment and Filters." Cake is scraped continuously from the filter and reslurried with ammonium hydroxide solution. This slurry is filtered on a continuous Oliver filter. The ammonium phthalate solution from the filter is recovered by evaporation. (Figure 5, "Ammonium Phthalate Evaporator").

Zirconium hydroxide cake from the Oliver filter falls from the filter scraper blade through a chute into a continuous gas-fired drier, manufactured by the Bartlett-Snow Company. This is shown in Figure 6, "Assembly Work on Drier - Third Floor." The dried zirconium hydroxide falls continuously into silica-lined calciners in which it is converted to high purity zirconium oxide, (Figure 7, "Calciner - Second Floor"). Calciners were also manufactured by the Bartlett-Snow Company, and liners are supplied by the Amersil Company and the General Ceramics Company.

Hafnium hydroxide is redissolved and purified by the same chemical process

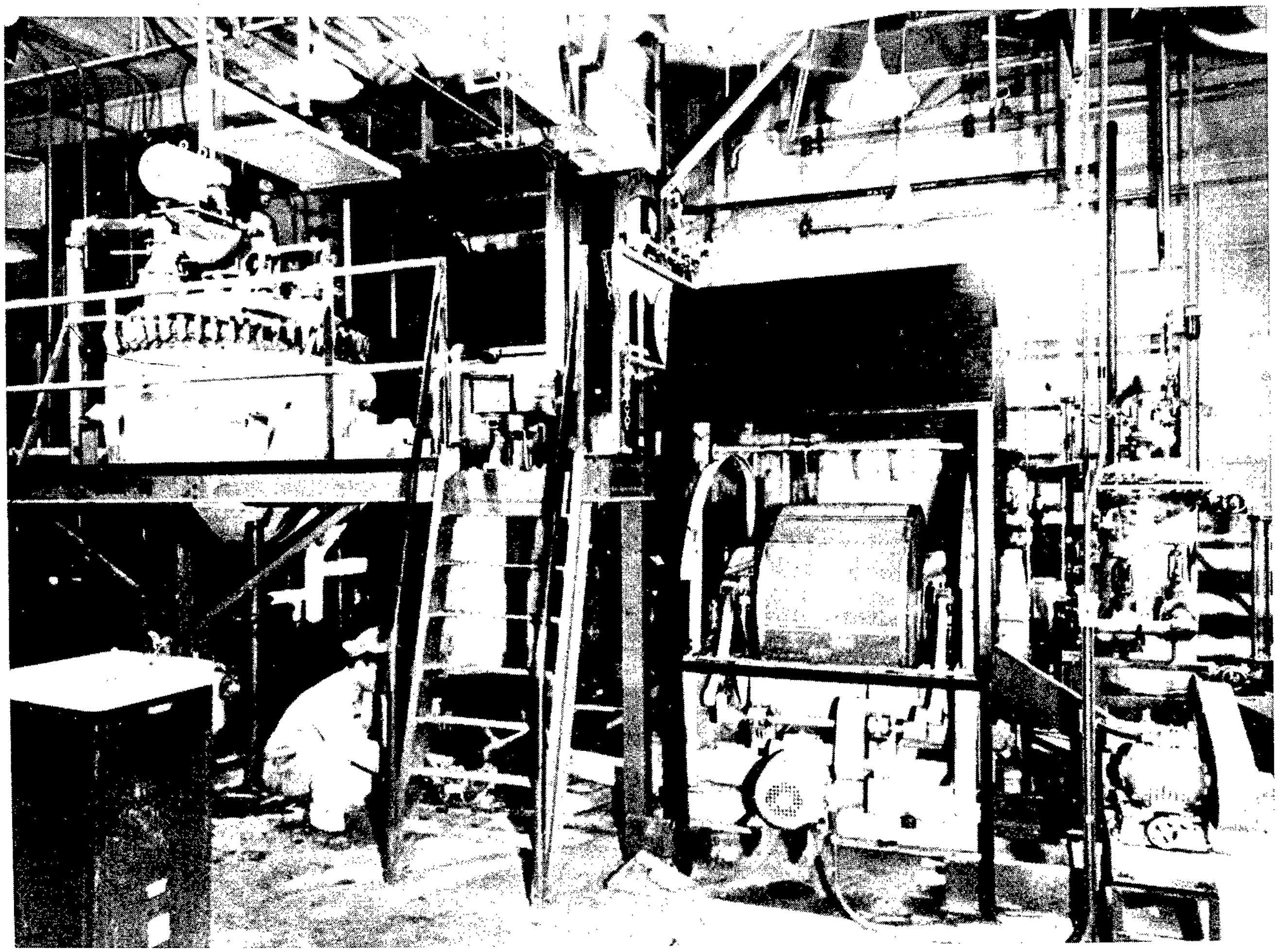


FIGURE 4. PHTHALATE PRECIPITATION EQUIPMENT AND FILTERS - FOURTH FLOOR

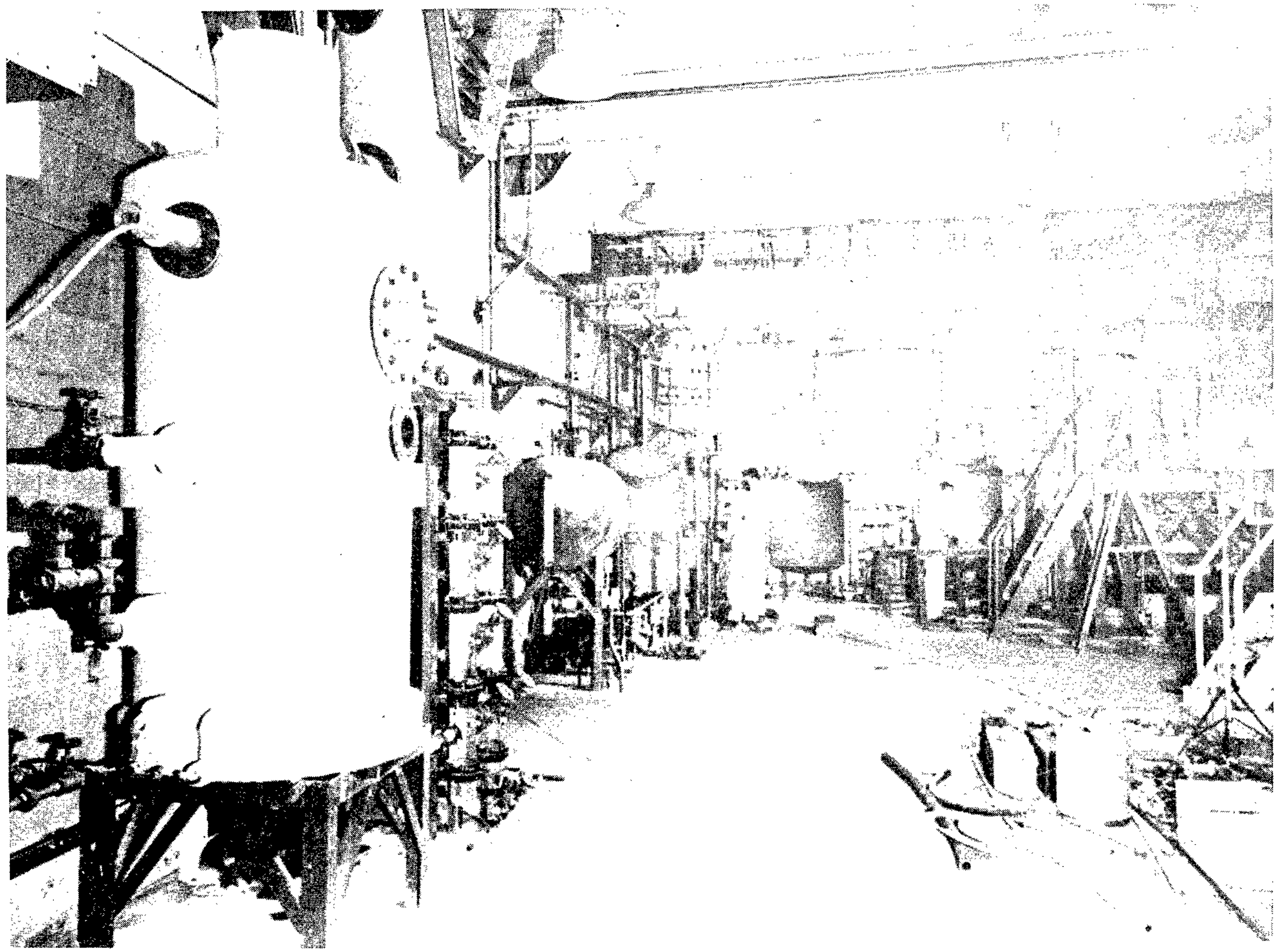


FIGURE 5. AMMONIUM PHTHALATE EVAPORATOR, MISCELLANEOUS HEAD TANKS IN BACKGROUND – FOURTH FLOOR

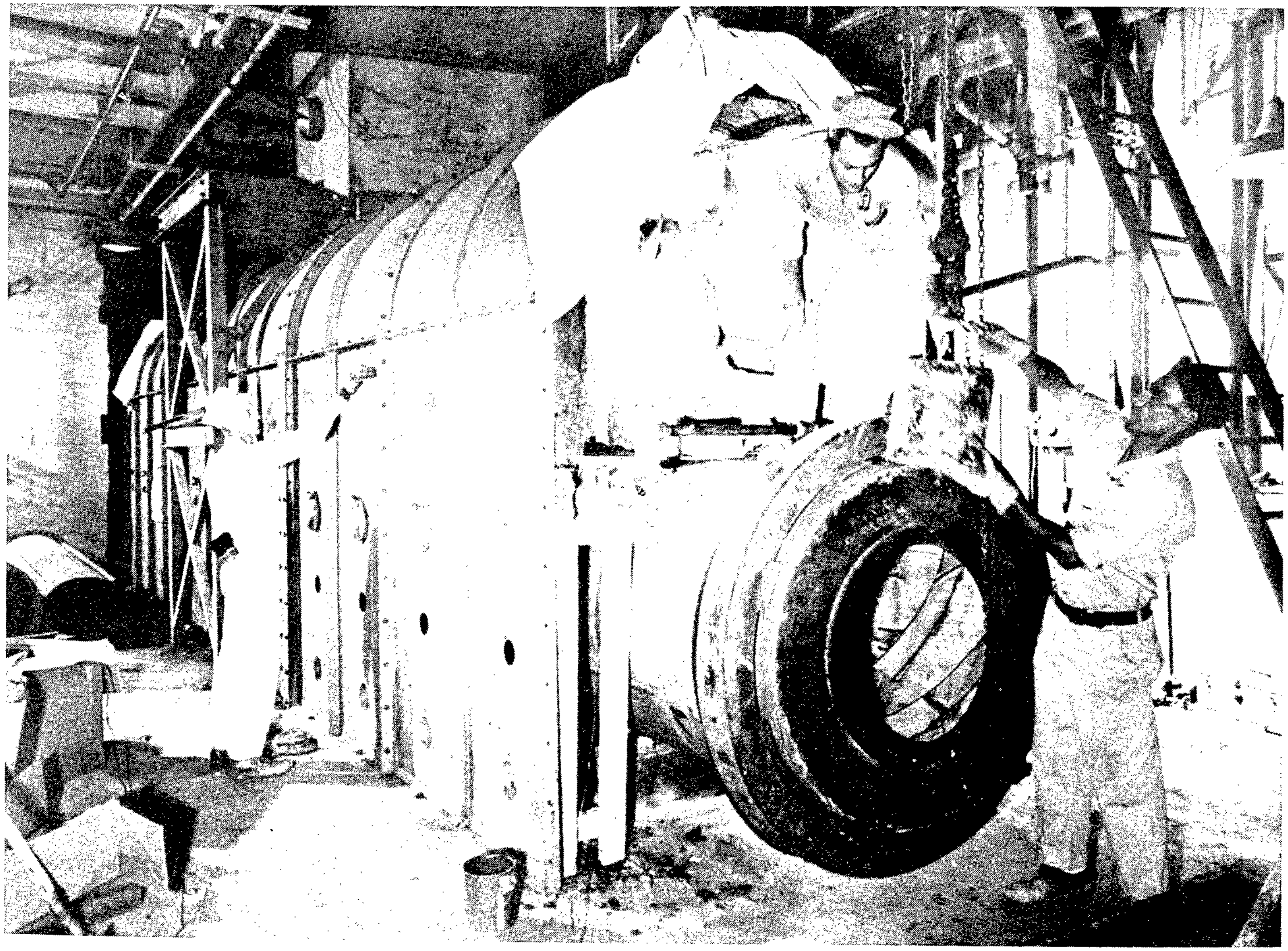


FIGURE 6. ASSEMBLY WORK ON DRIER – THIRD FLOOR

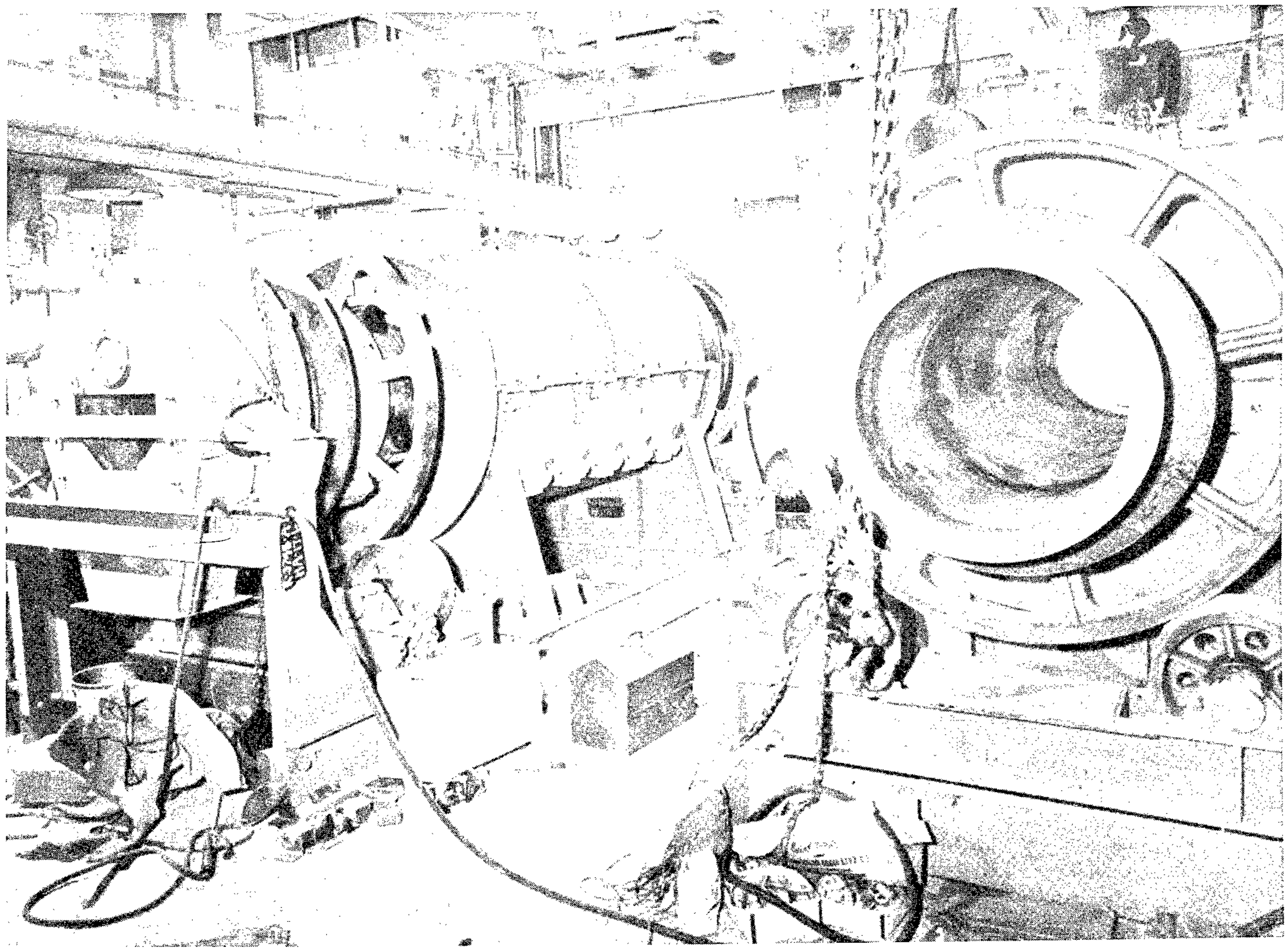


FIGURE 7. CALCINERS — SECOND FLOOR.

used for zirconium hydroxide. Some of the equipment in which this work is carried out may be seen in Figure 8, "Hafnium Purification Equipment."

Chlorination

The method of chlorination that was used at Y-12 consisted of direct chlorination of the oxide with carbon tetrachloride in a rotary horizontal reactor. Zirconium oxide was charged batchwise into the reactor. Carbon tetrachloride was fed through a vaporizer into the rotary reactor forming volatile zirconium tetrachloride. The zirconium tetrachloride gas was collected in an air-cooled condenser and cleaned batchwise into shipping containers. The reaction gases were scrubbed in a sodium hydroxide system, (Figure 9, "Control Panel and Condensers of Horizontal Chlorinators - First Floor").

MATERIALS OF CONSTRUCTION

Handling of Process Materials

General selection of materials of construction at various stages of processing is given in Table I, "Materials of Construction for Handling of Process Materials". This table gives the actual construction of the permanent zirconium plant. Selection has been made based on chemical resistance to process solutions of various materials, and availability of standby equipment at Y-12.

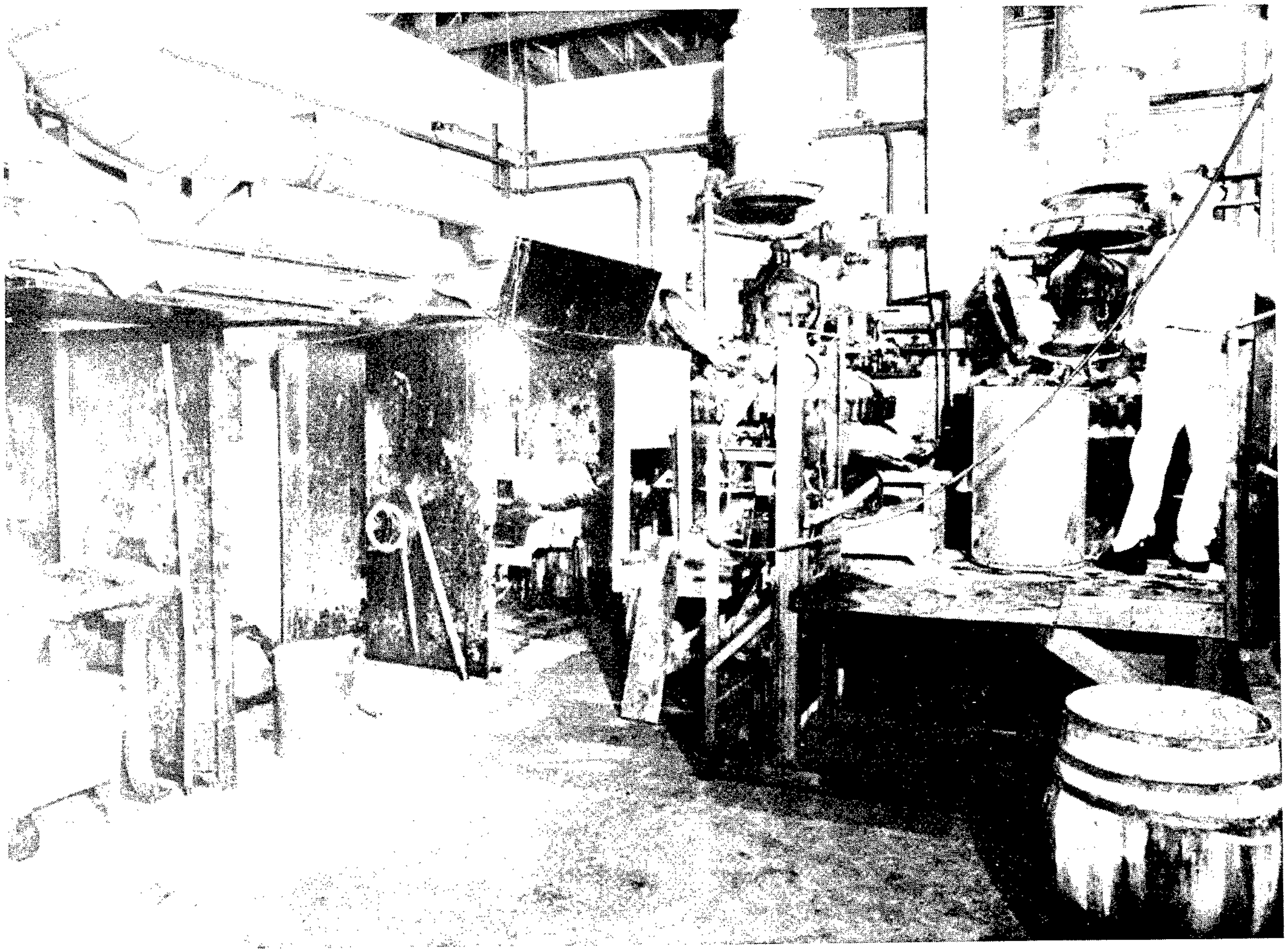


FIGURE 8. HAFNIUM PURIFICATION EQUIPMENT

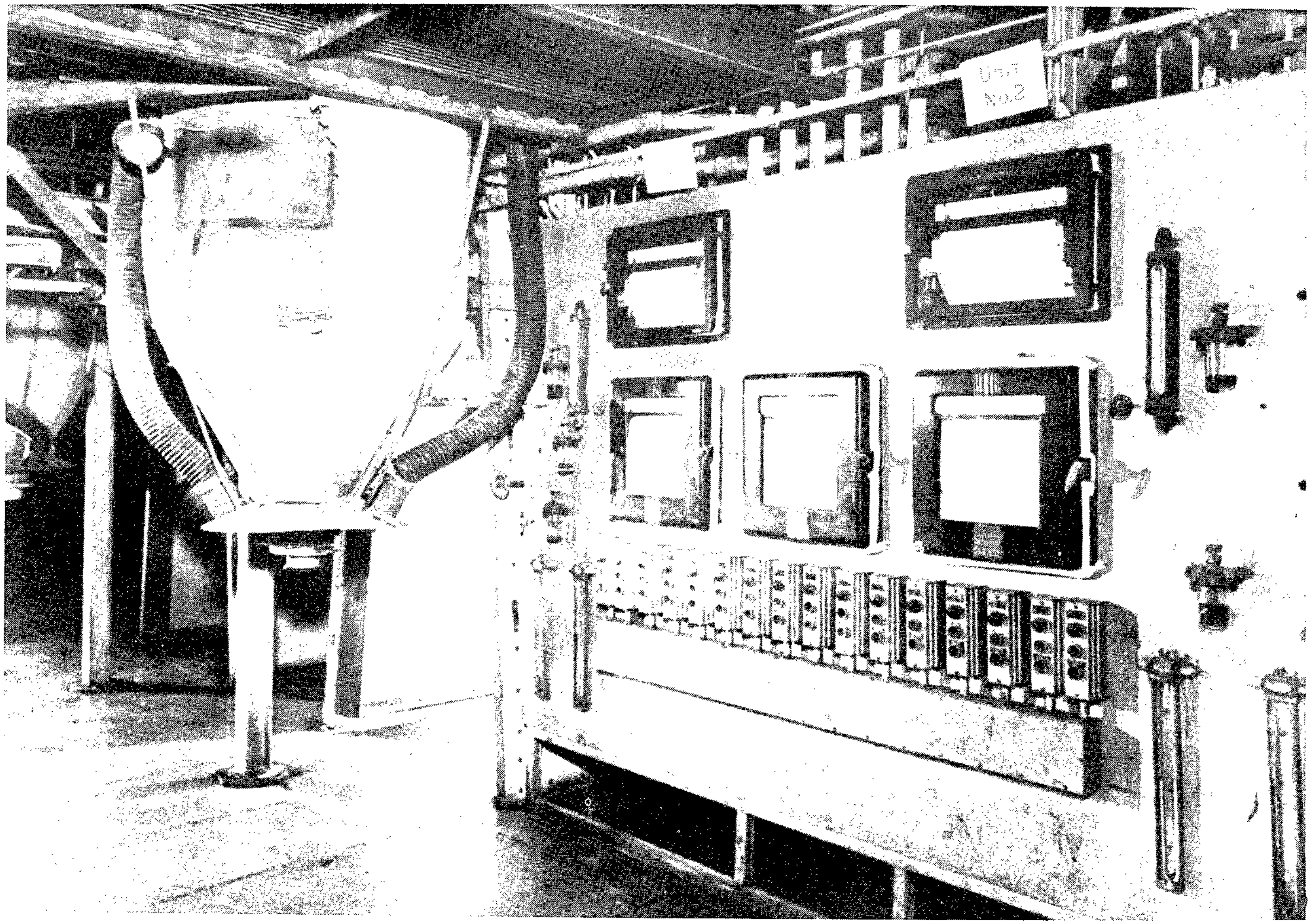


FIGURE 9. CONTROL PANEL AND CONDENSERS OF HORIZONTAL CHLORINATORS -FIRST FLOOR

TABLE I

MATERIALS OF CONSTRUCTION FOR HANDLING OF PROCESS MATERIALS

EXTRACTION	Tanks and Equipment	Pipe	Valves	Diaphragms	Pumps	Gaskets	Packing	Pump Lubrication
Aqueous Extraction Solution and Stripping Solution (0.2-0.5 mol HCl)	Glass-lined, Rubber-lined	Glass	Glass-lined	Tygon, Neoprene	Durchlor, Hastelloy C	Koroseal, Neoprene	Teflon, Durco 400-B	Nordcoseal 755-S Rockwell Mfg. Co., Pittsburgh
Hexone (Acid)	Glass-lined, Stoneware	Glass	Glass-lined	Neoprene	Durchlor, Hastelloy C	Neoprene	Teflon, Durco 400-B	Nordcoseal 755-S
Hexone (Neutral)*	Glass-lined, Stoneware	Glass	Glass-lined	Butyl Rubber Neoprene	-	Butyl Rubber, Neoprene	Teflon, Durco 400-B	Nordcoseal 755-S
Sulfuric Acid (5 Mol)	Glass-lined	Glass	Glass-lined	Tygon	-	Koroseal	Teflon	Nordcoseal 755-S
Sulfuric Acid (Conc.)	Black Iron	Black Iron, Glass	Black Iron	-	Black Iron, Carpenter 20 SS	-	Teflon	Nordcoseal 755-S
Conc. HCl (for Stripper Makeup)	Glass-lined	Glass	Glass-lined	Tygon	Haveg	Koroseal	Teflon	Nordcoseal 755-S
PURIFICATION								
Extraction Effluent	Glass-lined, Wood, Hastelloy C, Rubber-lined	Glass, Hard Rubber	Glass-lined, Rubber-lined	Tygon	Durchlor Hastelloy C	Koroseal	Teflon	Nordcoseal 755-S
Ammonium Phthalate Solution	SS 316	SS 316	SS 316	-	SS 316, Black Iron	Koroseal	Asbestos	Nordcoseal 755-S
Drying (to 300°C)	SS 316							Nordcoseal 755-S
Calcining (to 700°C)	Fused Quartz							Nordcoseal 755-S
CHLORINATION								
CCl_4	SS 316	Black Iron	Black Iron		Black Iron	-	Asbestos	Nordcoseal 755-S
$ZrCl_4$ Gas (above 350° C)	Carbon, Quartz							
$ZrCl_4$ Solid (below 350° C)	Nickel							

*Protection against acid is made since possibility of acid condition exists in most cases. Pure hexone is a good organic solvent but is not corrosive.

Background for selection is given in a report, Y-589, "Corrosion Study for a Chemical Processing Plant", Frank A. Knox, August, 1950.

In general it is found that HCNS in hexone is corrosive to about the same extent as HCl. Metals which can be used to resist this combination are Hastelloy C and Durchlor. Various rubber-like materials may be used for gasket material, although hexone is a solvent for many gasket and diaphragm materials. Butyl rubber and Neoprene appear to be the most satisfactory for resistance to neutral hexone. A large amount of process piping is standard Pyrex glass with flange fittings; this gives resistance to most of the process solutions and also provides visibility.

For resistance to sulfuric acid, glass has been used for dilute solutions. Concentrated sulfuric acid is handled in black iron, and carpenter 20 stainless steel is used as piston material in a metering pump where the piston is alternately exposed to sulfuric acid and the atmosphere.

Concentrated hydrochloric acid is handled in glass-lined tanks and glass piping. A Haveg metering pump is used for metering concentrated hydrochloric acid. Chemical resistance is good, although mechanical properties are not as satisfactory as desired.

In the phthalate purification step, an acid-resistant filter of wood is being

used. It is indicated at this time that a totally rubber-covered steel filter might be more suitable. Filter media for hydrochloric acid solutions is high temperature Vinyon or Dynell. Particle size is small and a tight weave is required.

The dryer is constructed of 316 stainless steel, which has been shown in the laboratory to be satisfactory up to 300 degrees Centigrade from the corrosion standpoint. Extensive tests on metals for calcining zirconium oxide failed to show a satisfactory metal. A fused quartz lined calciner was developed for this application in conjunction with the Bartlett-Snow Company, the Amersil Company, and the General Ceramics Company. Efficiency of this equipment will be shown by operation.

Materials of construction for zirconium chlorination are limited for zirconium tetrachloride in the gas phase. Fused quartz has been found to be resistant at very high temperatures. Carbon is good in the range of 350 to 650 degrees Centigrade. Nickel is good at 350 degrees Centigrade and below, and is fairly satisfactory up to 550 degrees Centigrade, although it gives some contamination in this range.

General Protection Against Corrosion

Operation of the temporary zirconium plant showed that a severe corrosion

problem can result from vapors of process solutions in the extraction and purification plants. However, general corrosion can be controlled by taking proper protective measures.

Structural supports for extraction columns are fabricated from 316 stainless steel angle and non-reusable stainless steel pipe. This stands up with only surface discoloration under the conditions present, that is, spills of dilute hydrochloric acid and vapors of HCl under oxidizing conditions.

Filters are completely enclosed and ventilated. Hoods for filters are constructed of 1/2 inch marine plywood and coated with one coat of Penkote protective coating.[1] Glass pipe flanges on the columns are cast iron coated with seven layers of a baked phenolic resin coating.[2] Nuts and bolts on flanges of columns are of stainless steel 316.

Duct work for feed makeup exhaust system is fabricated of 316 stainless steel coated with baked on Heresite. Duct work for exhaust on filter hoods is fabricated from mild steel coated with baked Heresite.

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[1] Penkote 500, Penisular Chemical Product Company, Van Dyke, Mich.

[2] Heresite P403, Heresite Chemical Company, Manitowoc, Wis.

PROCESS CONDITIONS AND EFFICIENCY

Extraction

Present operating conditions for the extraction columns are outlined as follows:

Length of Columns (Total)

Extraction	180 Ft.
Stripping	125 Ft.
Scrubbing	65 Ft.
Thiocyanate Recovery	55 Ft.
Hexone Rate	140 GPH
CNS Concentration in Recycle Hexone	2.7 Molar
HCl Rate, Stripping Section	18-20 GPH
HCl Concentration	3.5 Molar
CNS, Concentration In	0.0 Molar
CNS, Concentration Out	2.5-3.0 Molar
Feed Rate, Zirconium Oxychloride Solution	50 GPH
HCl Concentration	1 Molar
HCNS Concentration	2.6 Molar
Zr Concentration	1 #/gal.
H_2SO_4 Rate, Scrubber Solution	35 GPH
H_2SO_4 Concentration	5 Normal
CNS Conc., Feed to Thiocyanate Recovery Column	1.60 Molar
CNS Conc., Discharge from Thiocyanate Recovery Column	0.1 Molar
CNS Conc., Hexone to Column	0.0 Molar
CNS Conc., Hexone from Column	2.50 Molar
Rate of Hexone to Thiocyanate Recovery Column	40 GPH
Rate of Aqueous Solution in Column	70 GPH
Conc. Hf in Raw Feed	1.5-2.0 %
Conc. Hf in Product Zr	<100 PPM
Conc. Zr in Product Hf	Approximately 2 %

Yield of Zr Product Based on Feed Solution	96%
Percent Recycle of Hexone	96.5-97.0 %
Percent Loss of Hexone	3-3.5 %
Amount Makeup Hexone	90 Gals/day

	Optimum for Extraction Section	Optimum for Stripping Section
Distribution Coefficient Hf Org/Aq	1.5	0.7
Distribution Coefficient Zr Org/Aq	0.3	0.15
Separation Factor	4-5	4-5

Operation of the extraction units is carried out to achieve the best balance between product purity and yield of zirconium. Increased purity of zirconium can be obtained at the expense of yield and Hf purity. With the present method of operation it is possible to obtain a yield of better than 96% of Zr containing less than 100 ppm Hf while obtaining hafnium product containing between 0.5% and 3.0% Zr.

Purification

Efficiency of the purification plant has not yet been established, and it is expected that considerable process improvement work will be required to obtain maximum efficiency. It is expected that 98 % yield of zirconium will be obtained and that product purity will be equal to, or better than, purity of product

from the initial installation based on batch operation.

Phthalate recovery is expected to be about 80 percent. Recovery efficiency is very dependent on filter operation and wash distribution on the filter.

Recycle of ammonium hydroxide from the evaporator may be a practical step for economy. It is planned to add fractionating and condensing equipment for recovery and recycle of ammonium hydroxide if it is economically justified.

Drying and Calcining

Operating experience with the rotary equipment is limited but serious dust losses are not anticipated. Available rotoclones and scrubbers will be activated if necessary.

Operating Costs

Typical operating costs are given in the following tables. Table II gives the cost for ZrO_2 production in the month of January, 1951. Table III gives cost for ZrO_2 production total for the fiscal year July, 1950 through April, 1951.

These costs resulted from operation of the temporary zirconium production

facilities. Considerable economies in both labor and materials are expected from operation of the permanent zirconium plant. Estimated costs in report Y-573, p10, are expected to be in line with actual cost if allowance is made for general price advances.

TABLE II

UNIT COST OF ZRO_2 PRODUCTION, JANUARY, 1951

		Total Cost		Cost Per Pound Zr Produced
		$93,523		$3.002
Material				
Ammonium Hydroxide	1584		.051	
Lime	133		.004	
Hydrochloric Acid	1874		.061	
Salicylic Acid	38934		1.251	
Sulfuric Acid	658		.021	
Ammonium Thiocyanate	10057		.323	
$ZrCl_4$	35165		1.129	
Hexone	2186		.070	
Natural Gas	693		.022	
Steam	1534		.049	
Treated Water	536		.017	
Electricity	134		.004	
Operating Labor, Direct		13,667		.439
Maintenance, Labor, & Material		15,763		.506
Allocated Plant Expense		12,455		.400
Analytical		3,740		.120
Miscellaneous*		9,128		.293
Total		$148,276		$4.761

Pounds Zirconium as Oxide Produced - 31,134

*Protective Clothing, Shipping Charges, Janitorial Services, Etc.

TABLE III

UNIT COST ZRO_2 PRODUCTION FROM JULY, 1950 THRU APRIL, 1951

		Total Cost		Cost/lb.
Material		$731,971		$2.943
Ammonium Hydroxide	$13,041		.052	
Lime	1,710		.007	
Hydrochloric Acid	22,408		.090	
Salicylic Acid	278,764		1.121	
Sulfuric Acid	3,679		.015	
Ammonium Thiocyanate	89,211		.359	
$ZrCl_4$	287,050		1.154	
Hexone	14,985		.060	
Caustic Flake	41.		.000	
Natural Gas	5,807		.023	
Steam	10,821		.044	
Treated Water	3,280		.013	
Electricity	1,174		.005	
Operating Labor		110,385		.443
Maintenance, Labor, & Material		148,453		.596
Allocated Plant Expense		124,067		.498
Analytical		33,471		.135
Miscellaneous		88,920		.357
Total		$1,237,267		$4.972

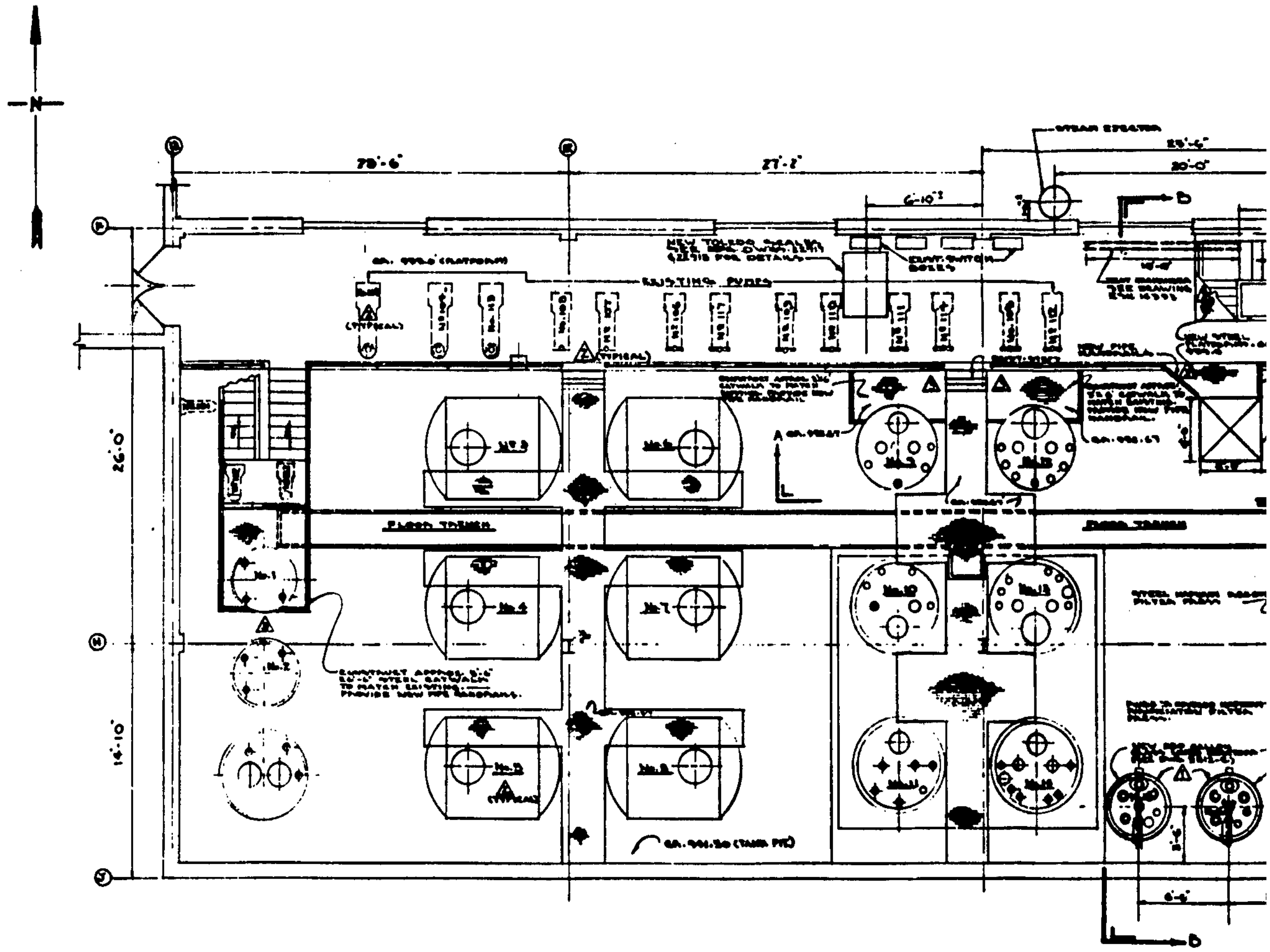
Pounds Zirconium as Oxide Produced - 248,751

BIBLIOGRAPHY OF Y-12 LITERATURE BEARING ON PRODUCTION OF ZIRCONIUM MATERIALS

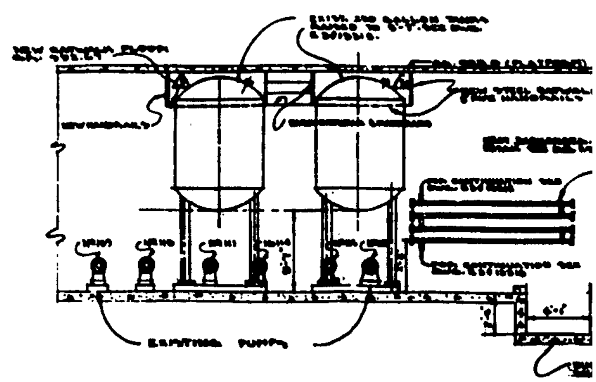
Bibliographies of Y-12 reports and reports of the MIT Practice School (Y-B4-43 and Y-B4-44) have been prepared by Mrs. Frances Sachs of the Y-12 Technical Information Center. Reports listed in these bibliographies contain important background material regarding the present processes for extraction, purification, and chlorination of zirconium materials at Y-12.

CONSTRUCTION DRAWINGS

Reduced drawings are given of principal engineering designs used in construction of the permanent zirconium plant. Drawings were prepared by Mr. F. S. Patton of the Engineering Department at Y-12 and were used as the basis of field instruction to construction personnel.

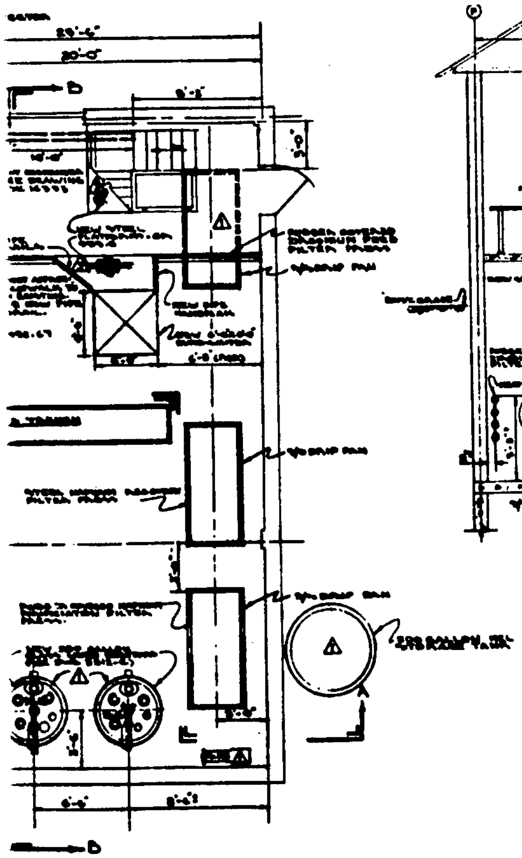


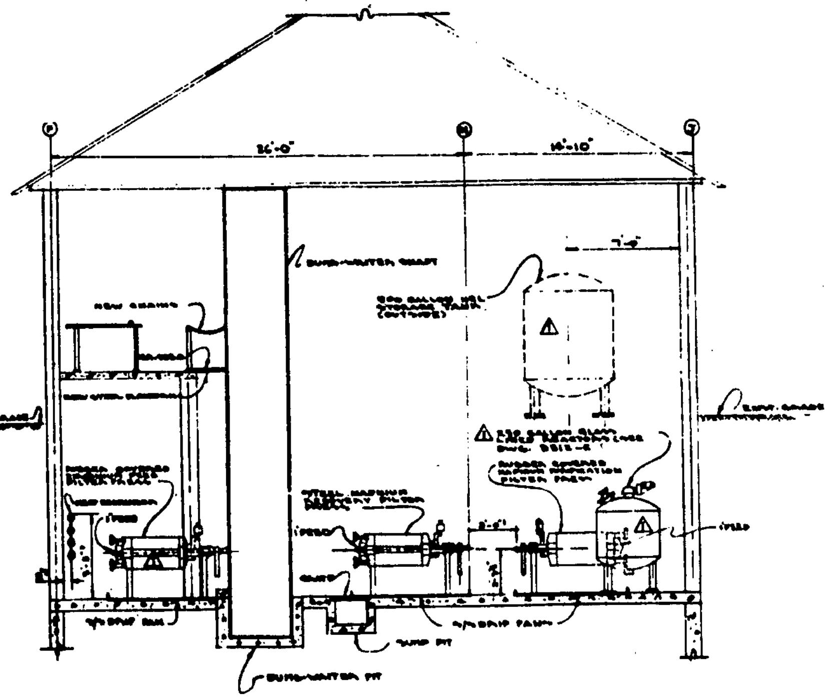
TANK FARM PLAN



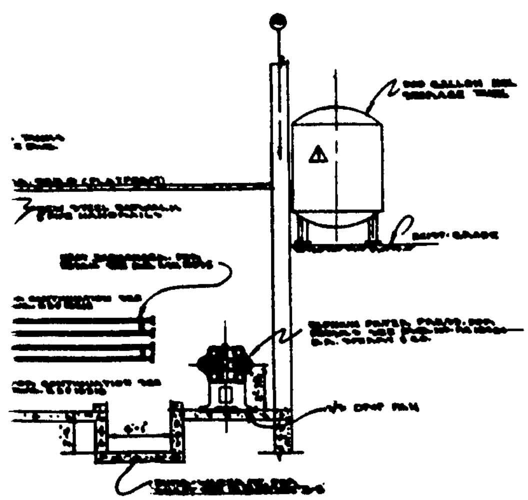
ELEVATION—"A-A"

PERMANENT ZIRCONIUM PLANT EQUIPMENT LOCA





ELEVATION—BB



AA

TANK SCHEDULE

1,6,7 & 8 — PHTHALATE STORAGE
2 — NH_4OH
3 — FEED STORAGE
4 & 5 — PRODUCT STORAGE
9,10,12 & 13 — FEED MAKEUP AREA
11,14,15 & 16 — HAFNIUM

PUMP SCHEDULE

P—101 DURICHLOR MODEL [illegible] — 1 H.P.
P—102 PROPORTIONEER DUPLEX — 1/4 H.P.
P—103 DURICHLOR MODEL [illegible]-104 — 10 HP
P—104 DURICHLOR MODEL [illegible]-104 — 10 HP
P—105 DURICHLOR MODEL [illegible]-104 — 10 H.P.
P—106 [illegible] MODEL [illegible] — 3 HP
P—107 [illegible] MODEL [illegible] — 3 HP
P—108 DURICHLOR MODEL [illegible] 104 — 10 H.P.
P—109 [illegible] MODEL [illegible] — 3 HP
P—110 DURICHLOR MODEL [illegible] 62 (SPARE) — 3 HP
P—111 DURICHLOR MODEL [illegible] 62 — 3 HP
P—112 DURICHLOR MODEL [illegible] 74 — 1/2 HP
P—113 DURICHLOR MODEL [illegible] 104 — 10 HP
P—114 DURICHLOR MODEL [illegible]-62 — 3 HP
P—115 DURICHLOR MODEL [illegible] 60 — 1 HP
P—117 DURICHLOR MODEL [illegible] 62 — 3 HP
P—122 DURICHLOR MODEL [illegible] 104 — 10 HP

REF. DWG'S.

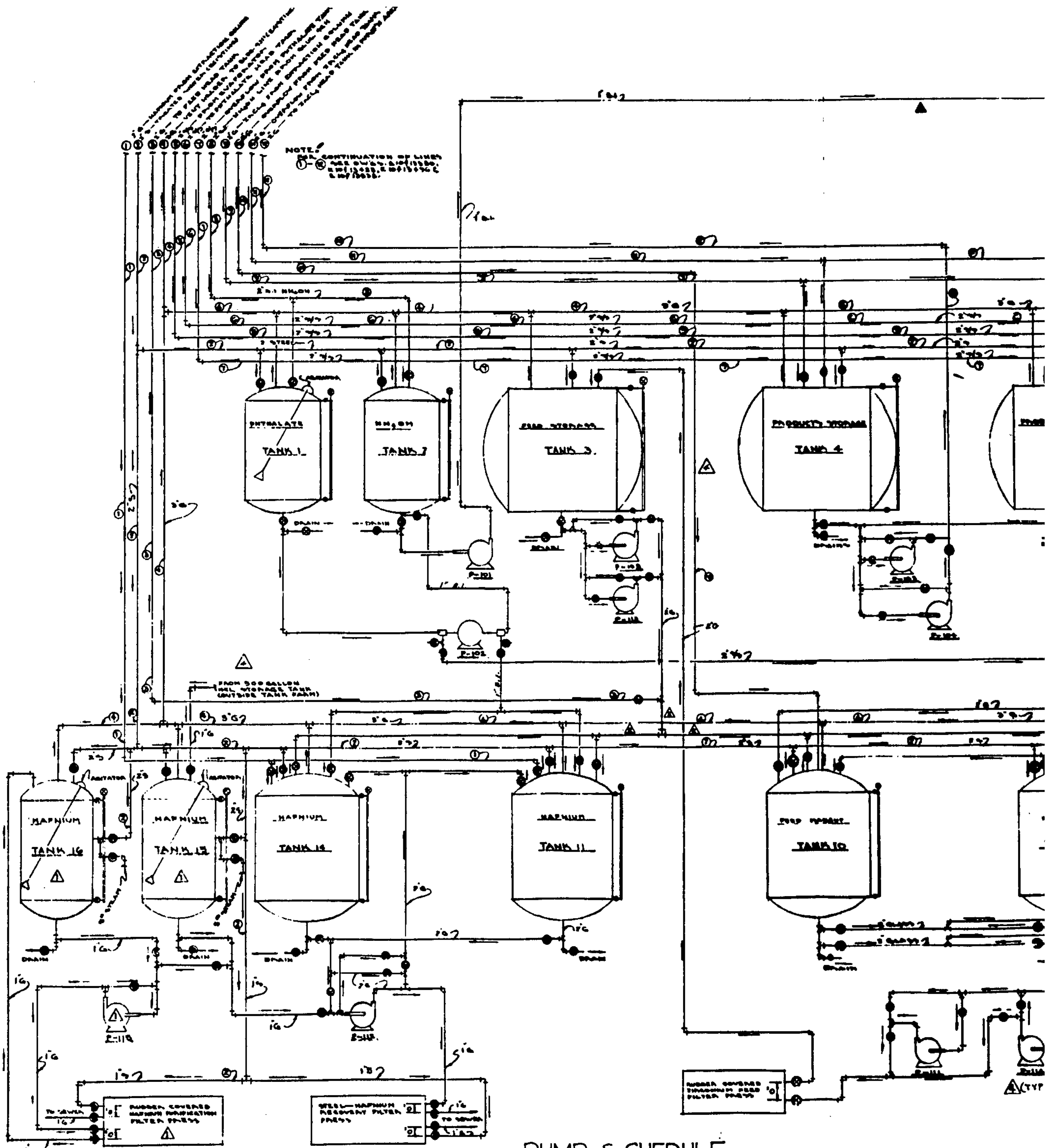
E9K 15348 — PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA — FLOW DIAGRAM.
E10K 15494 — PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA — LUCITE COVERS.
E9K 14993 — PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA — HEAT EXCHANGER
E9K 14664 — PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA — FEED [illegible]
E9K 14633 — PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA — REACTOR [illegible]
C9K 14667 — PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA — SCALES EXHAUST HOOD
E.C 15494 — 18 TYPE S.C. FILTER PRESS, D.R. SPERRY & CO.
9812-C — 250 GALLON REACTOR—GLAS COTE PRODUCTS, INC.
22917 — PIT LAYOUT — TYPE 9900 — TOLEDO SCALES
22918 — FRAME DETAILS — TYPE 9900 TOLEDO SCALES

GEN. NOTES

1. — DIMENSIONS SHOWN MAY BE VARIED TO MEET FIELD CONDITIONS.
2. — EXISTING EQUIPMENT SHOWN IN LIGHT LINES WHILE NEW EQUIPMENT IS IN HEAVY.
3. — FILTERS TO BE EQUIPPED WITH SUITABLE SIZED DRIP PANS CONSTRUCTED IN FIELD.
4. — FOR FRAME & PIT DETAILS OF TOLEDO SCALES SEE MANUFACTURERS DWGS. 22917 & 22918
5. — FOR LOCATION OF SCALES SEE DRAWING C9K 14667.
6. — DUMB WAITER REMOVED FROM BLDG. 9207 & INSTALLED IN BUILDING 9211 AS SHOWN. INSTRUCTIONS FOR BOTH IN W.O. [illegible].
7. — FOR EXHAUST TO FEED MAKEUP AREA SEE DWGS. E9K 14664, E9K 14633 & C9K 14667.

IPMENT LOCATION-FEED MAKEUP AREA, PLAN & ELEVATIONS

2



PUMP SCHEDULE

P—101 DURICHLOR MODEL A-2MBR-60 (1 H.P.)
P—101 PROPORTIONEER DUPLEX PUMP (3/4 H.P.)
P—103 DURICHLOR MODEL A 265 R 104 (10 HP)
P—104 DURICHLOR MODEL A 265 R 104 (10 HP)
P—105 DURICHLOR MODEL A 265 R 104 (10 HP)
P—106 DURCO KA 25 MO MODEL H 25 MDR 22 OR 24 (3 H.P)
P—107 DURCO KA 25 MO MODEL H 25 MDR 22 OR 24 (3 HP)
P—108 DURICHLOR MODEL A-265 R 104 (10 HP)
P—109 DURCO KA 25 MO MODEL H 25 MDR 22 OR 24 (3 H.P)
P—110 DURICHLOR MODEL A-50 R 62 (3 HP) (SPARE)
P—111 DURICHLOR MODEL A-50 R 62 (3 HP)
P—112 DURICHLOR MODEL A-3 MDR 74 (1/2 HP)
P—113 DURICHLOR MODEL A-265 R 104 (10 HP)
P—114 DURICHLOR MODEL A-50 R 62 (3 HP)
P—115 DURICHLOR MODEL A-2 MBR-60 (1 HP)
P—117 DURICHLOR MODEL A-50 R 62 (3 HP)
P—122 DURICHLOR MODEL A-265 R-104 (10 H.P)

LEGEND

INDICATES
INDICATES
INDICATES
INDICATES
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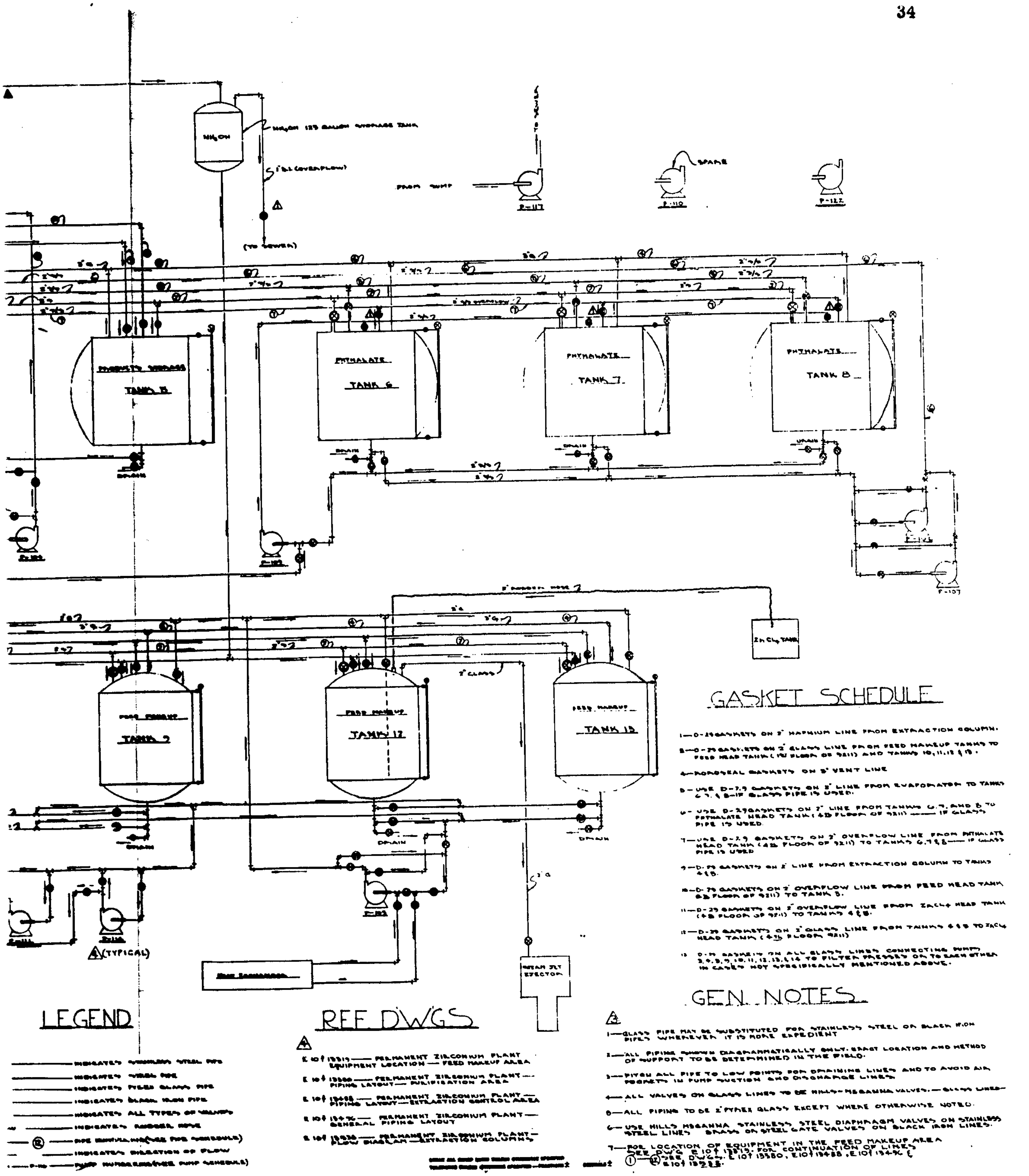
INDICATES
INDICATES

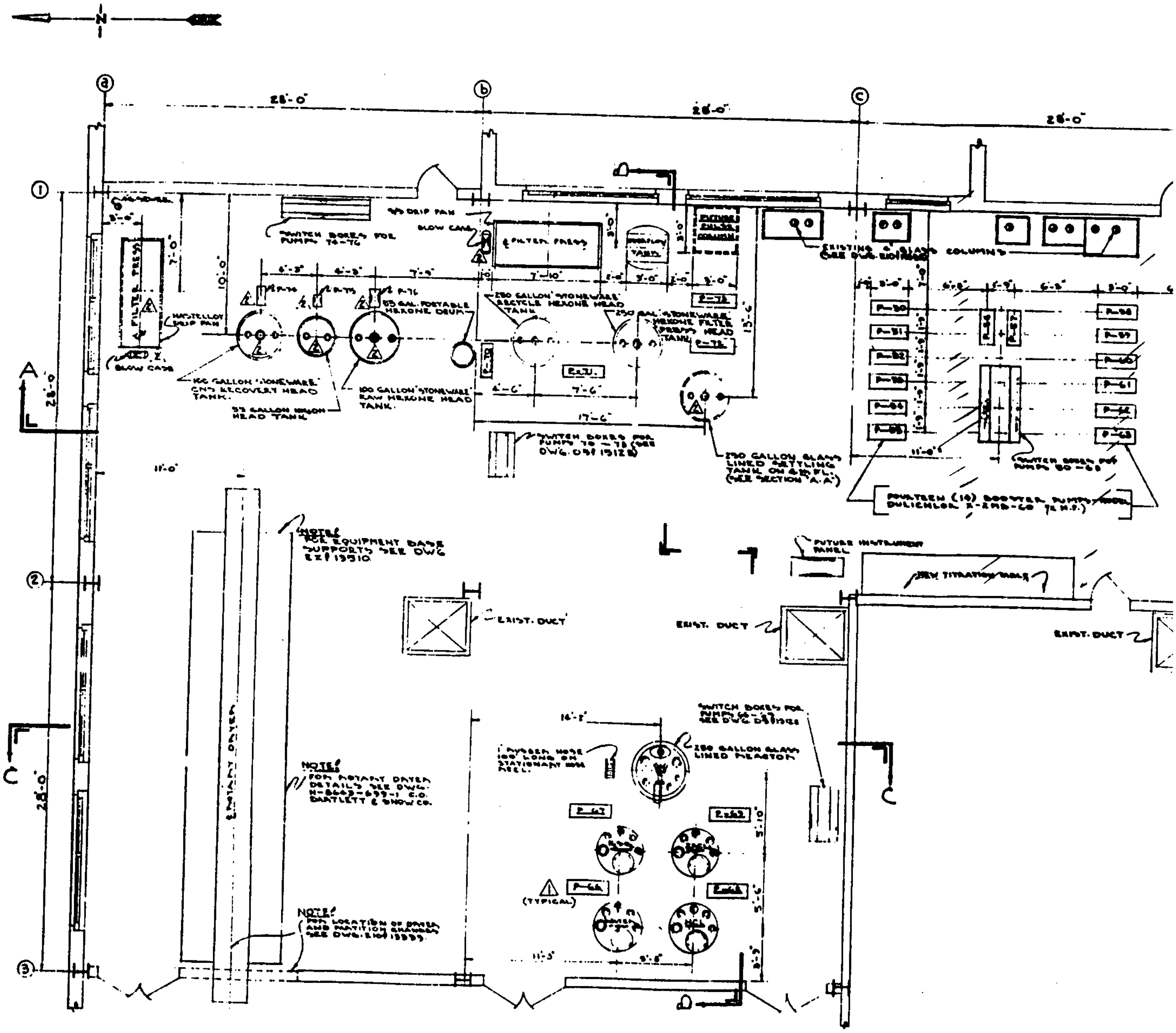
PIPE MARK SCHEDULE

1 — 2" GLASS — HAFNIUM LINE FROM EXTRACTION COLUMN (NEW)
2 — 2" STEEL — TREATED WATER SUPPLY FROM BLDG. 9211 (EXISTING)
3 — 2" GLASS — FROM MAKEUP TANKS TO FEED HEAD TANK (NEW)
4 — 3" GLASS — VENT HEADER TO BLDG. 9211 (EXISTING)
5 — 2" S/STEEL — FROM EVAPORATOR TO TANKS 6,7, AND 8 (NEW)
6 — 2" S/STEEL — TO PHTHALATE HEAD TANK FROM TANKS 6,7,&8 (NEW)
7 — 2" S/STEEL — FROM PHTHALATE HEAD TANK TO TANKS 6,7,&8 (NEW)
8 — 2" B IRON — NH_4OH LINE FROM BLDG. 9211 (NEW)
9 — 2" GLASS — $ZrCl_4$ FROM EXTRACTION COLUMN TO TANKS 4&5 (NEW)
10 — 2" GLASS — OVERFLOW FROM FEED HEAD TANK & THIOCIANATE RETURN LINE
11 — 2" GLASS — OVERFLOW FROM $ZrCl_4$ HEAD TANK TO TANKS 4&5 (NEW)
12 — 2" GLASS — FROM TANKS 4&5 TO $ZrCl_4$ HEAD TANK (NEW)

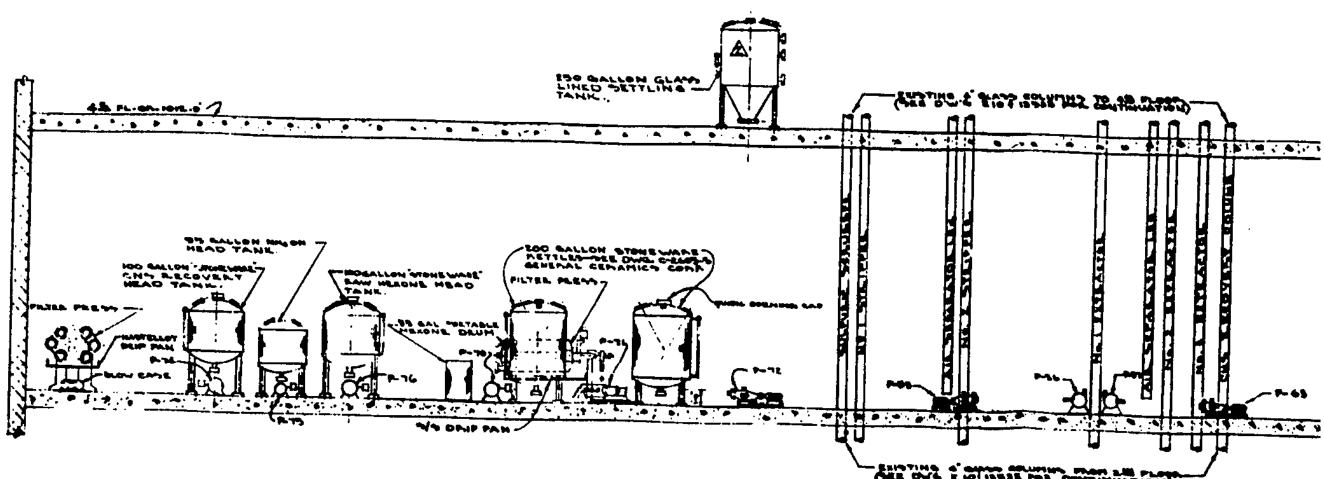


PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM, FEED MAKEUP AREA

(2)



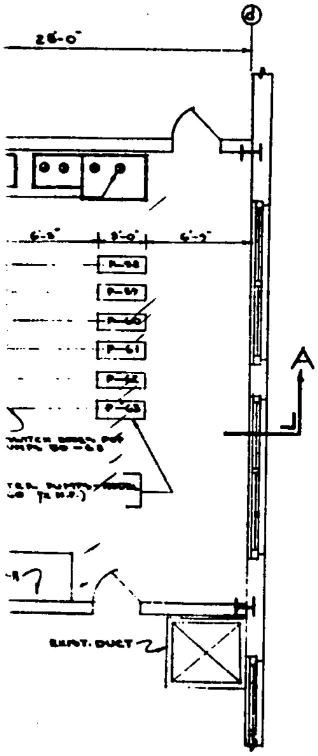
PART PLAN—3RD FL
(EXCEPTION NOTED)

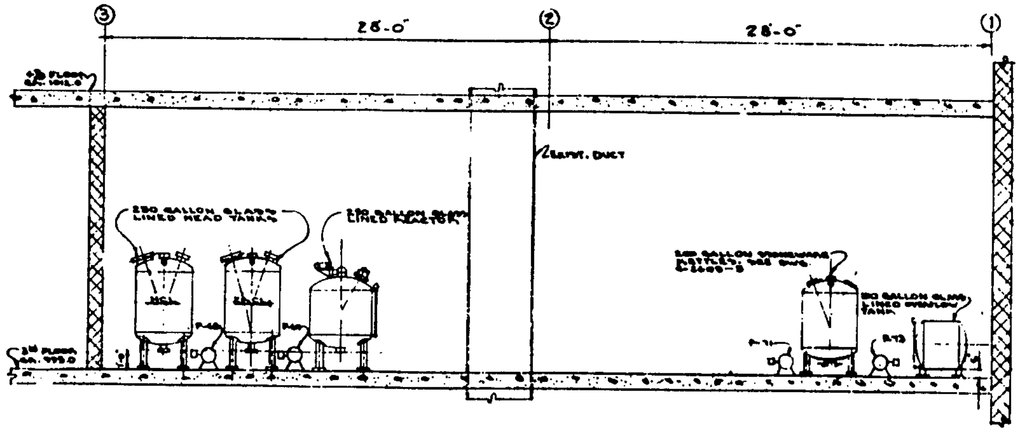


SECTION—'A-A'

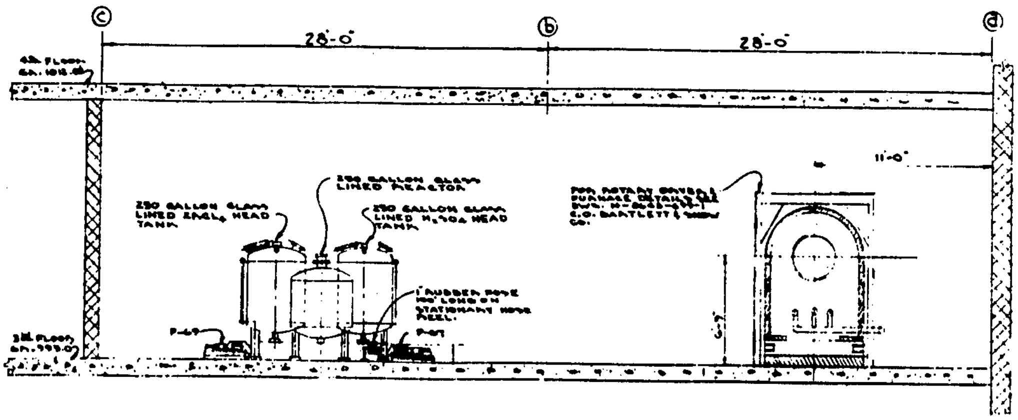
PERMAN

1





SECTION—BB



SECTION—CC

PUMP SCHEDULE

2

P-60 — P-65 DURICHLOR [illegible]-ZMD-60 ([illegible])
P—66 MILTON ROY DUPLEX
P—67 MILTON ROY SIMPLEX
P—68 MILTON ROY DUPLEX
P—69 MILTON ROY SIMPLEX (HASTELLOY)
P—70 MILTON ROY SIMPLEX
P—71 MILTON ROY SIMPLEX
P—72 DURICHLOR [illegible] ZMD 60 (1 H.P)
P—73 MILTON ROY SIMPLEX (HASTELLOY)
P—74 DURICHLOR [illegible]-62
P—75 MILTON ROY SIMPLEX ([illegible])
P—76 MILTON ROY SIMPLEX (HASTELLOY)

REF. DWG'S.

2

E104 10359 —— PERMANENT ZIRCONIUM PLANT— EQUIPMENT LOCATION — PURIFICATION & CALCING AREA — PLAN & SECTIONS.

E104 10588 —— PERMANENT ZIRCONIUM PLANT— FLOW DIAGRAM — EXTRACTION COLUMNS.

E104 10487 —— PERMANENT ZIRCONIUM PLANT— PIPING LAYOUT —— EXTRACTION CONTROL

E 24 10310 —— PERMANENT ZIRCONIUM PLANT— EQUIPMENT BASES — 3RD FLOOR.

D 3 K 14646 —— PERMANENT ZIRCONIUM PLANT— FILTER PRESS EXHAUST SYSTEM.

D 34 10128 —— PERMANENT ZIRCONIUM PLANT— ONE LINE DIAGRAM —— EXTRACTION CONTROL AREA.

M-3643-699-1 —— ROTARY DRYER —— C.O. BARTLETT & SNOW CO.

R.C. 18494 —————— SPERRY FILTER PRESS— D.R. SPERRY & CO.

C 2605-5 ———— 200 GALLON STONEWARE KETTLE —— GENERAL CERAMICS CORP.

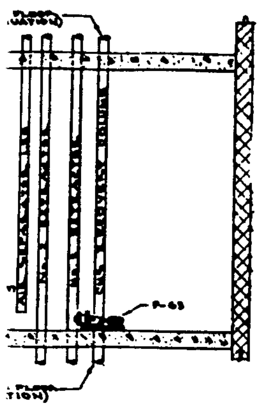
3812 – C ———— 250 GALLON GLASS LINED REACTOR —— GLASCOTE PRODUCTS.

G 7 8838-1 250 GALLON EFFLUENT HEAD TANK ALLOY FABRICATORS, INC.

GEN. NOTES

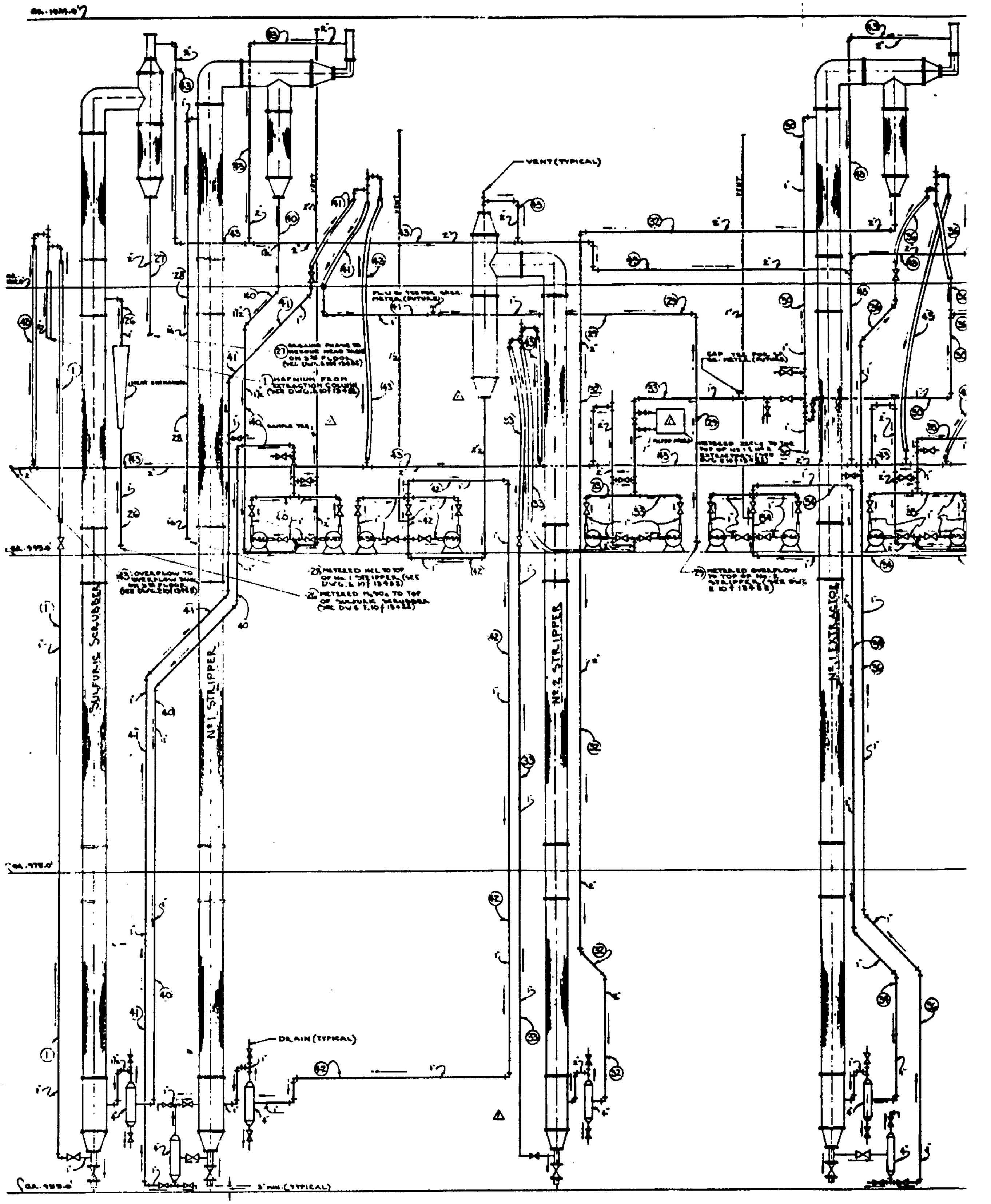
2

1 — ALL EQUIPMENT SHOWN ON 3RD FLOOR TO BE NEW EXCEPT AS NOTED.
2 — ALL TANK SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
3 — DIMENSIONS SHOWN ARE APPROXIMATE AND MAY BE VARIED TO MEET FIELD CONDITIONS.
4 — SEE MANUFACTURERS DRAWINGS FOR DETAILS OF ROTARY DRYER, FILTER PRESS, 200 GAL. STONEWARE KETTLE, GLASS LINED REACTOR, & 250 GALLON HEAD TANKS.
5 — NEW PUMPS (INDICATED BY P-60 — P-76) TO BE LOCATED APPROXIMATELY WHERE SHOWN BUT EXACT LOCATION TO BE DETERMINED BY FIELD.
6 — ALL FILTERS TO BE EQUIPPED WITH EITHER STAINLESS STEEL OR HASTELLOY DRIP PANS AS NOTED. SIZE & CONSTRUCTION OF DRIP PANS TO BE DETERMINED BY FIELD.
7 — TITRATION TABLE TO BE SIZED & CONSTRUCTED BY FIELD.
8 — SWITCH BOXES FOR PUMPS 60 — 76 TO BE LOCATED APPROXIMATELY WHERE SHOWN BUT MAY BE VARIED TO MEET FIELD CONDITIONS.
9 — INSTRUMENT PANEL (FUTURE) TO BE FOR SPECIFIC GRAVITY METERS.
10 — ALL TANKS TO HAVE SIGHT GLASSES. SIZE OF SIGHT GLASSES DEPENDS UPON AVAILABLE OPENINGS.
11 — FOR FILTER PRESS EXHAUST SYSTEM SEE DWG. D3K 14646.

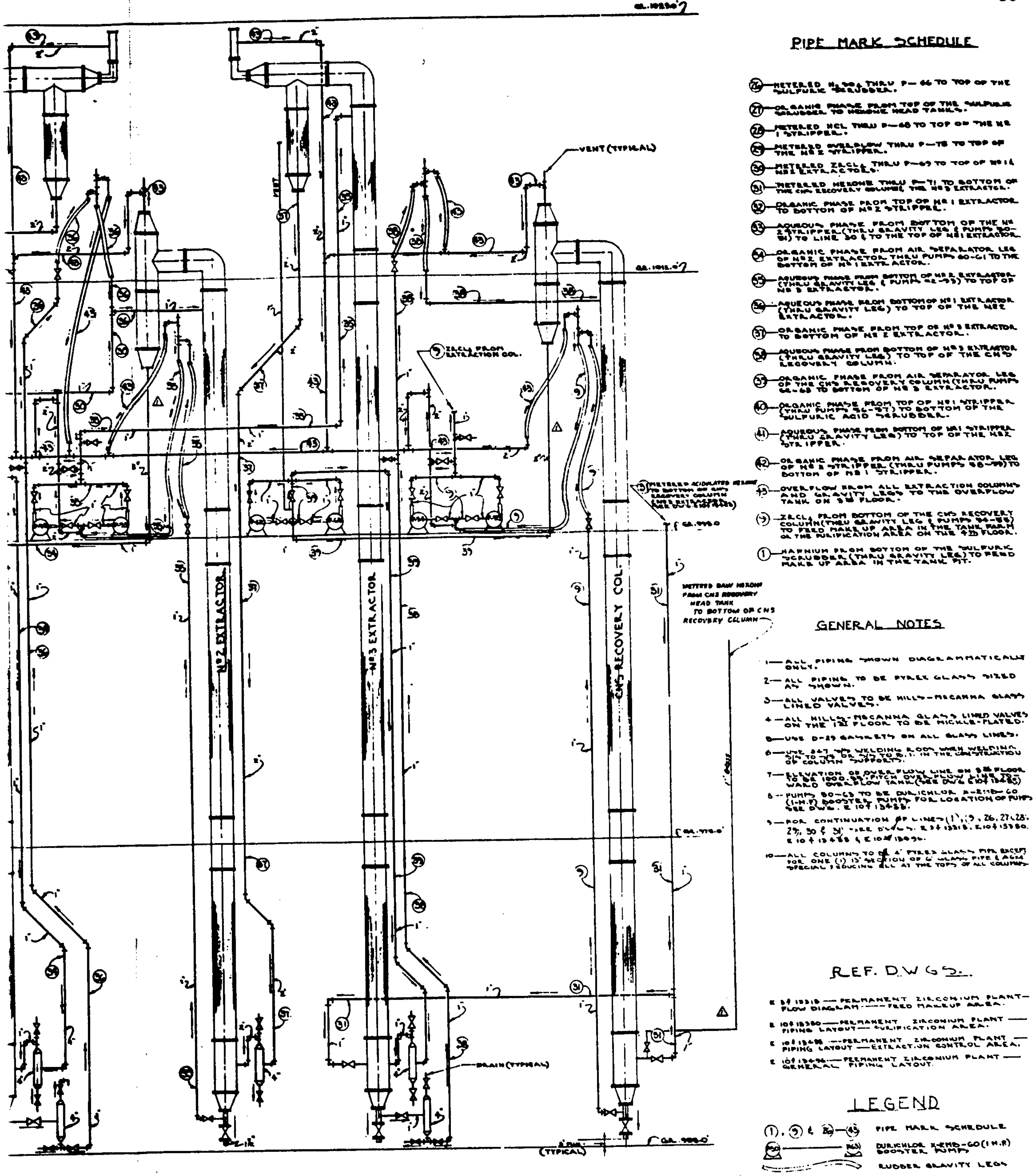


PERMANENT ZIRCONIUM PLANT EXTRACTION CONTROL AREA EQUIPMENT LOCATION-PLAN & SECTION

2

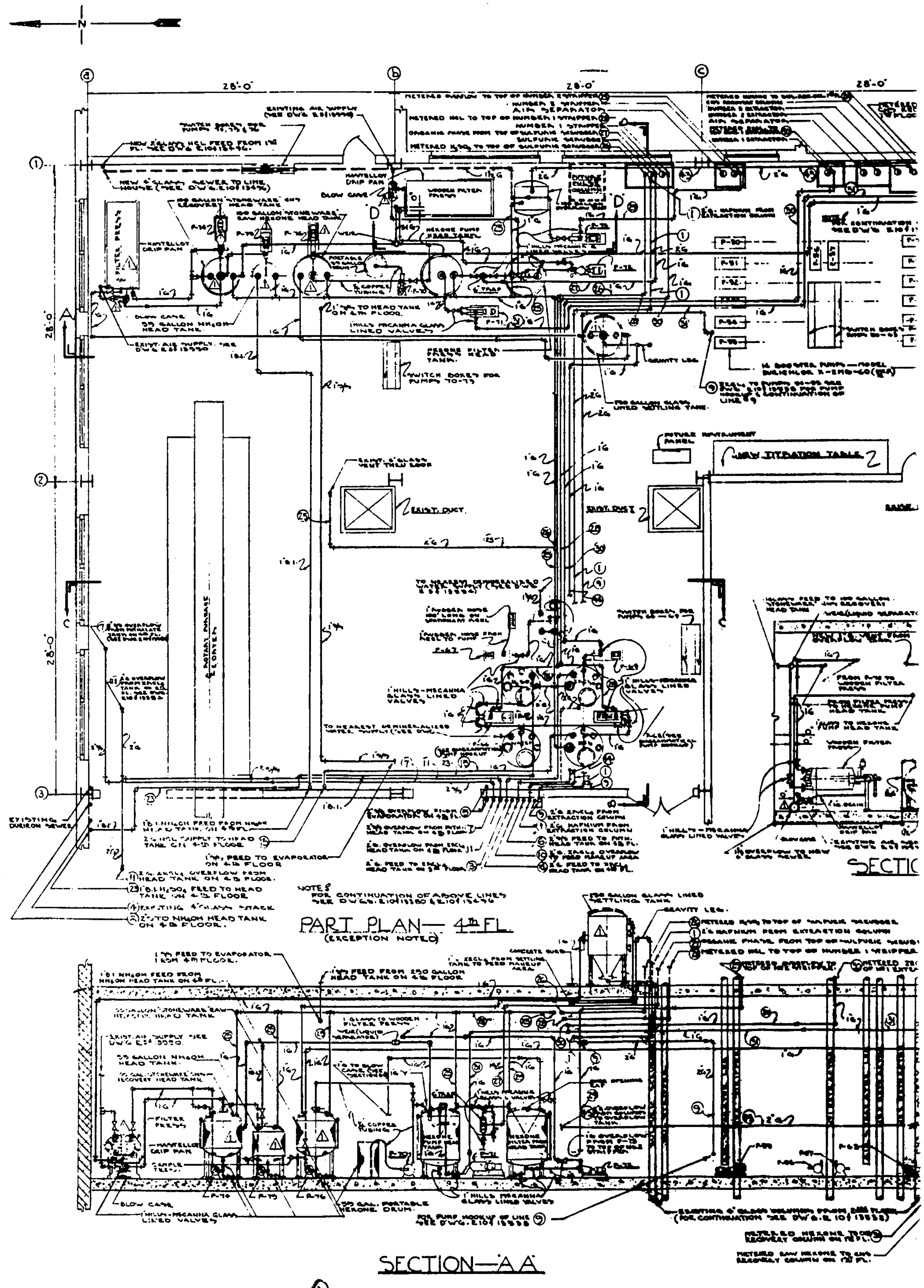


FLOW DIAGRAM



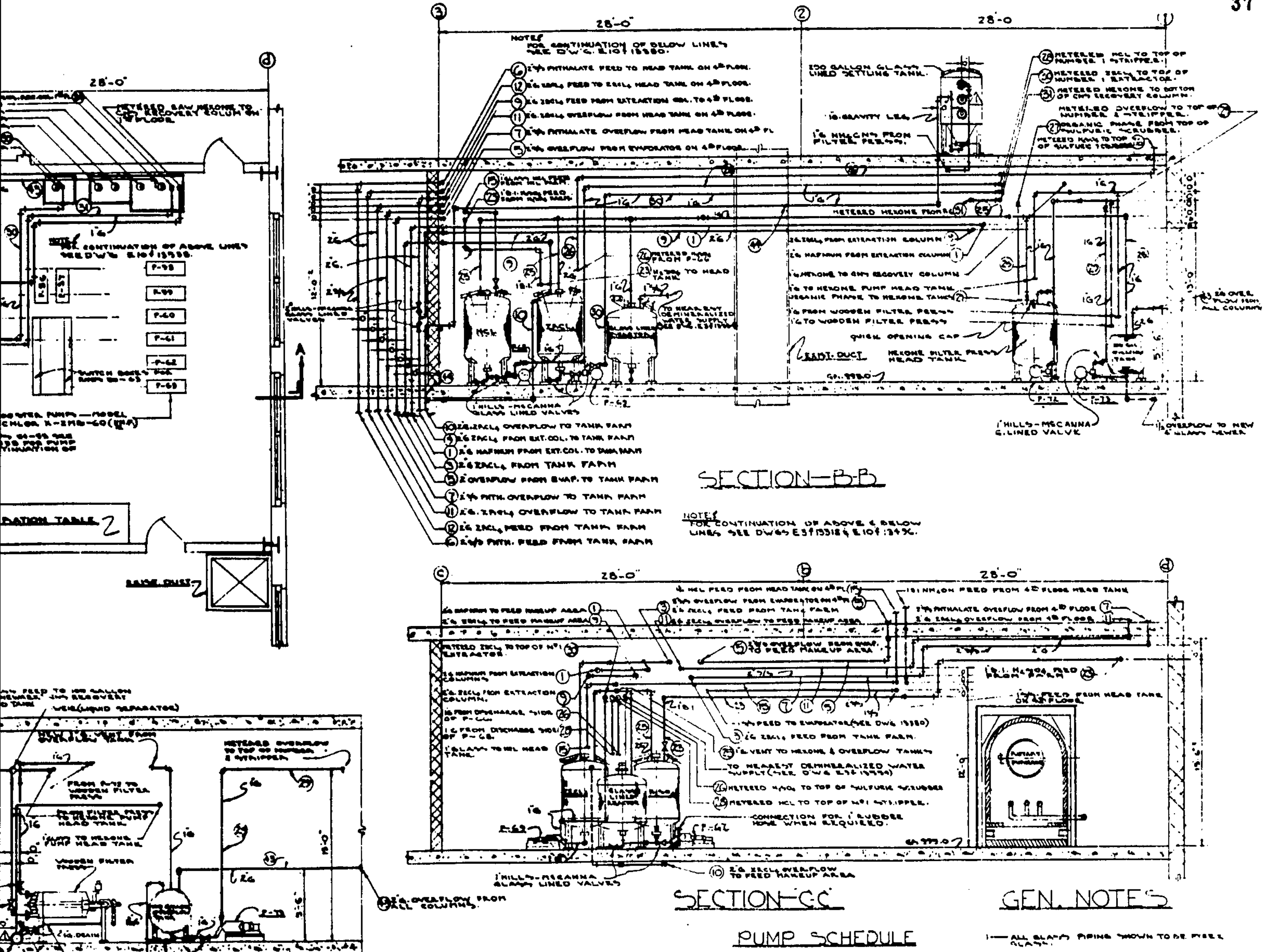
PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM EXTRACTION COLUMNS

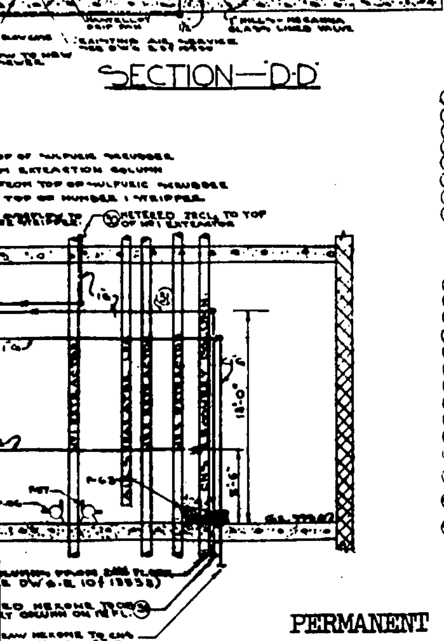
2



PART PLAN— 4th FL.
(EXCEPTION NOTED)
SECTION—AA
SECTIC
NOTES
FOR CONTINUATION OF ABOVE LINES SEE DWGS. E101 13380 & E101 13476
28'-0"

1





PIPE MARK SCHEDULE:

- (4) — 4" G. VENT THRU ROOF (EXISTING)
- (5) — 2" S/S OVERFLOW FROM EVAPORATOR ON 4th FL.
- (6) — 2" S/S FEED TO PHTHALATE HEAD TANK ON 4th FL.
- (7) — 2" S/S PHTHALATE OVERFLOW FROM 4th FLOOR.
- (8) — 2" S TO NH_4OH HEAD TANK ON 4th FLOOR.
- (11) — 2" G. OVERFLOW FROM $ZrCl_4$ HEAD TANK ON 4th FL.
- (12) — 2" G. FEED TO $ZrCl_4$ HEAD TANK ON 4th FLOOR.
- (13) — 2" G. FEED TO HCL HEAD TANKS ON 3rd & 4th FLOORS.

NOTES

SEE DWG. E 3f 15519 FOR A FLOW DIAGRAM OF THE FEED MAKEUP AREA USING ALL OF ABOVE LINES

- (1) — 2" G HAFNIUM FROM EXTRACTION COLUMN.
- (3) — 2" G TO $ZrCl_4$ FEED HEAD TANK ON 3rd FLOOR.
- (9) — 2" G. $ZrCl_4$ FROM EXTRACTION COLUMN.
- (10) — 2" G $ZrCl_4$ OVERFLOW FROM FEED HEAD TANK.
- — 1½" G. VENT TO ALL TANKS ON 3rd FL. (EXCEPT WATER).
- — 1" G. METERED H_2SO_4 TO TOP OF SULFURIC SCRUBBER.
- — 1" G. ORGANIC PHASE FROM TOP OF SULFURIC SCRUBBER
- — 1" G. METERED HCL TO TOP OF NUMBER 1 STRIPPER.
- — 1" G. METERED OVERFLOW TO TOP OF No 2 STRIPPER.
- — 1" G. METERED $ZrCl_4$ TO TOP OF No 1 EXTRACTOR.
- (31) — 1" G. METERED HEXONE TO THE BOTTOM OF CNS RECOVERY COLUMN.
- (23) — 1" B.I. H_2SO_4 FROM ACID FARM TO H_2SO_4 HEAD TANK ON 3rd FLOOR.
- (43) — 2" G. OVERFLOW FROM ALL COLUMNS TO THE OVERFLOW TANK.
- (44) — NH_4CNS FROM SETTLING TANK TO FEED MAKEUP AREA (VIA LINE D)

PUMP SCHEDULE

- P 50 — P-65 — DURICHLOR MODEL K 2MB-60 (½ HP)
- P-66 — MILTON ROY DUPLEX
- P-67 — MILTON ROY SIMPLEX
- P-68 — MILTON ROY DUPLEX
- P-69 — MILTON ROY SIMPLEX (HASTELLOY)
- P-70 — MILTON ROY SIMPLEX
- P-71 — MILTON ROY SIMPLEX
- P-72 — DURICHLOR-K 2MB 60 (1 HP)
- P-73 — MILTON ROY SIMPLEX (HASTELLOY)
- P-74 — DURICHLOR-K 50R 62
- P-75 — MILTON ROY SIMPLEX (SS)
- P-76 — MILTON ROY SIMPLEX (HASTELLOY)

LEGEND

- — — — — HIDDEN LINES
- B.I — BLACK IRON
- S/S — STAINLESS STEEL
- S — STEEL
- G. — GLASS
- (1) — (43) — PIPE MARK SCHEDULE
- P50 — P-76 — PUMP SCHEDULE

GEN. NOTES

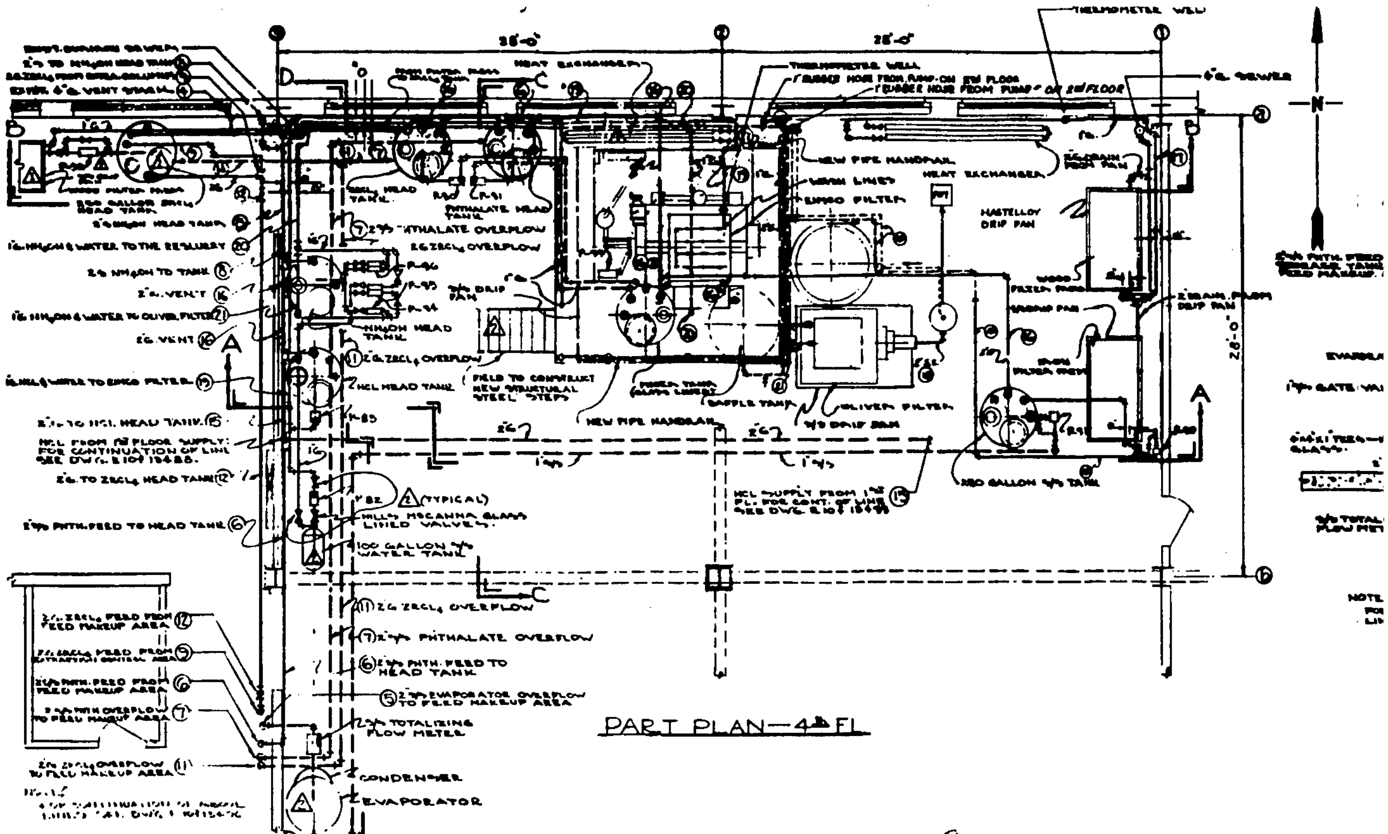
1 — ALL GLASS PIPING SHOWN TO BE PYREX GLASS.
2 — ALL VALVES ON GLASS LINES TO BE HILLS MCCANNA GLASS LINED VALVES.
3 — ALL PIPING SHOWN MAY BE VARIED TO MEET FIELD CONDITIONS.
4 — PIPE SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
5 — ALL TANKS TO HAVE SIGHT GLASSES. SIZE OF SIGHT GLASSES DEPENDS ON AVAILABLE OPENINGS.
6 — USE EXISTING PIPE RACKS WHEREVER POSSIBLE. EXISTING PIPE RACKS ARE APPROXIMATELY 15'-0" ABOVE FLOOR.
7 — FILTERS TO BE EQUIPPED WITH DRIP PANS AS NOTED. SIZE & CONSTRUCTION OF PANS TO BE DETERMINED BY FIELD.
8 — SAMPLE TEES TO BE ON THE DISCHARGE SIDE OF ALL PUMPS.
9 — TRAPS FOR ORGANIC PHASE TO BE GLASS GLASS TEES — 18" LONG — 3" OPENINGS TO REDUCE TO 1" OPENINGS.
10 — TRAPS FOR SUCTION SIDE OF ALL PROPORTIONING PUMPS TO BE 3" X 3" X 1" GLASS TEES — 12" LONG — 3" OPENINGS TO REDUCE TO 1" OPENINGS. SEE DIAGRAMMATICAL PUMP HOOKUP DWG. E 10f 15560
11 — FOR EQUIPMENT LOCATION IN THE PURIFICATION & CALCINING AREA SEE DWG. E 10f 15559. — FOR EQUIPMENT LOCATION IN THE EXTRACTION CONTROL AREA SEE DWG. E 10f 15487.
12 — FOR SERVICE PIPING TO ABOVE TANKS SEE DWG. E 3f 15554.

REF. DWGS

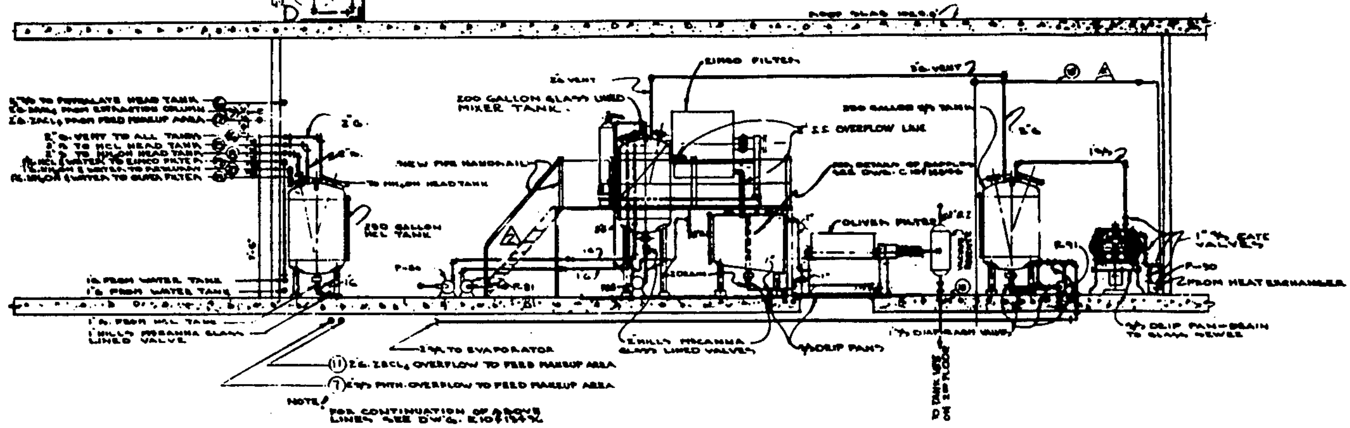
- E 3f 15518 — PERMANENT ZIRCONIUM PLANT — FLOW DIAGRAM — FEED MAKEUP AREA.
- E 3f 15554 — PERMANENT ZIRCONIUM PLANT — SERVICE PIPING — EXTRACTION CONTROL AREA.
- E 10f 15580 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — PURIFICATION AREA
- E 10f 15487 — PERMANENT ZIRCONIUM PLANT — EQUIPT. LOCATION — EXTRACTION CONTROL AREA.
- E 10f 15496 — PERMANENT ZIRCONIUM PLANT — GENERAL PIPING LAYOUT
- E 10f 15538 — PERMANENT ZIRCONIUM PLANT — FLOW DIAGRAM — EXTRACTION COLUMNS.

PERMANENT ZIRCONIUM PLANT PIPING LAYOUT-EXTRACTION CONTROL AREA, PLANS & SECTIONS

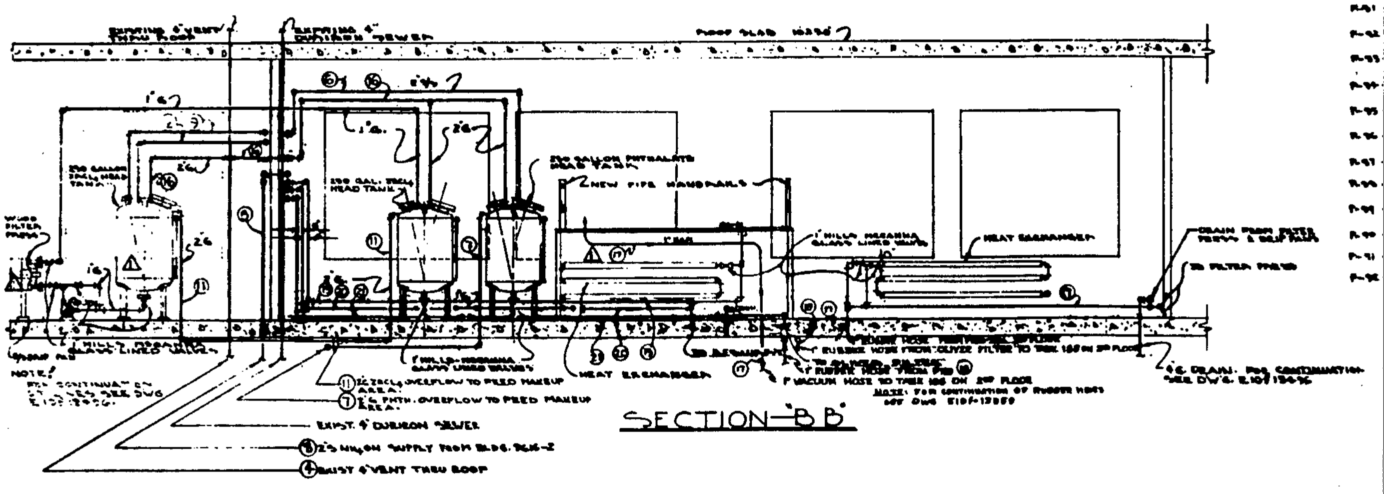
d



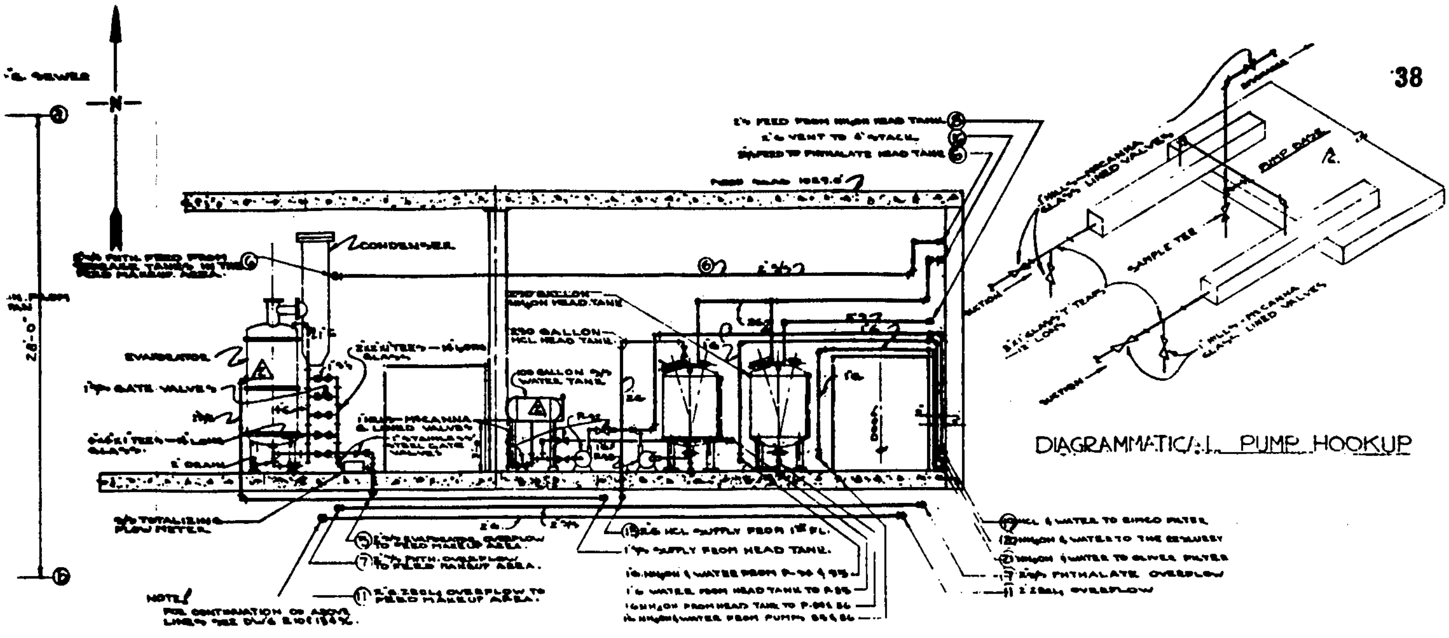
PART PLAN—4th FL



SECTION—'A A''

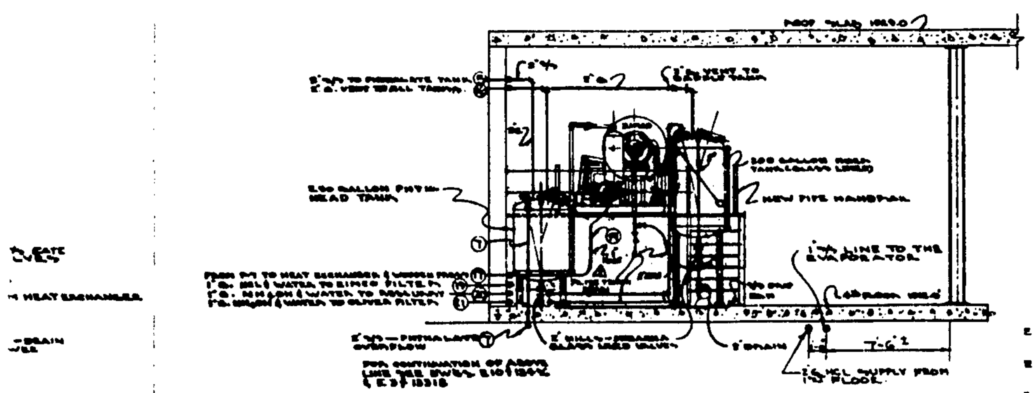


SECTION—'B B''



DIAGRAMMATIC PUMP HOOKUP

SECTION-"DD"



SECTION-"CC"

LEGEND

- S/S — STAINLESS STEEL
- S — STEEL
- G — PYREX GLASS PIPE
- B.I. — BLACK IRON
- FLEXIBLE RUBBER HOSE
- P-80—P-92 PUMP NUMBERING (SEE PUMP SCHEDULE)
- (4)—(21) PIPE NUMBERING (SEE PIPE MARK SCHEDULE)
- HIDDEN LINES (UNDER FLOOR OR PLATFORM)

REF. DWG'S.

- E 10-13355 — PERMANENT ZIRCONIUM PLANT — EQUIPMENT LOCATION — PURIFICATION & CALCINING AREAS.
- E 10-13496 — PERMANENT ZIRCONIUM PLANT — GENERAL PIPING LAYOUT
- E 10-13485 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — EXTRACTION CONTROL AREA.

PUMP SCHEDULE

P-80	MILTON ROY SIMPLEX	HASTELLOY
P-81	MILTON ROY SIMPLEX	STAINLESS STEEL
P-82	MILTON ROY SIMPLEX	STAINLESS STEEL
P-83	MILTON ROY SIMPLEX	7/8" HAVEG
P-84	MILTON ROY SIMPLEX	STAINLESS STEEL
P-85	MILTON ROY DUPLEX	STAINLESS STEEL
P-86	HILLS MCCANNA DUPLEX	STAINLESS STEEL
P-87	VACUUM PUMP (H-4)	NASH HYTOR
P-88	MIXER PUMP	[illegible]
P-89	VACUUM PUMP	NASH HYTOR
P-90	[illegible] PUMP	STAINLESS STEEL
P-91	[illegible] PUMP	STAINLESS STEEL
P-92	[illegible] MODEL [illegible] (1 HP)	

PIPE MARK SCHEDULE

- (9) 2" G. ZrCl₄ FROM EXTRACTION COLUMN
- (4)— 3" G. VENT FROM 1ST FL. TO EXISTING 4" STACK
- (5)— 2" S/S FROM EVAPORATOR ON 4TH FLOOR.
- (6)— 2" S/S FEED TO PHTHALATE HEAD TANK ON 4TH FLOOR.
- (7)— 2" S/S PHTHALATE OVERFLOW FROM 4TH FLOOR.
- (8)— 2" S. FEED TO NH_4OH HEAD TANK ON 4TH FLOOR.
- (11)— 2" G. OVERFLOW FROM $ZrCl_4$ HEAD TANK ON 4TH FL.
- (12)— 2" G. FEED TO $ZrCl_4$ HEAD TANK ON 4TH FLOOR.

NOTE

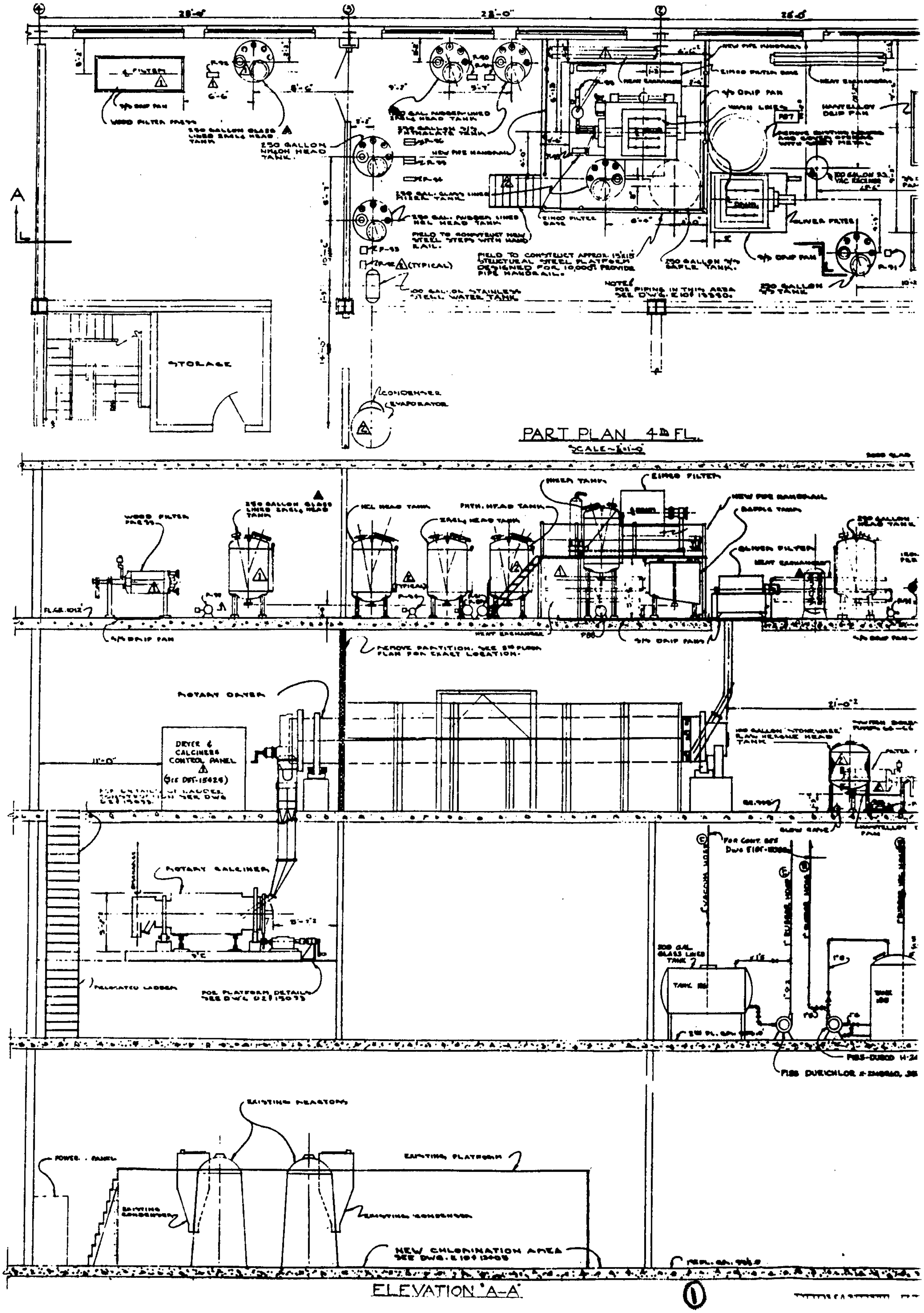
SEE DWG. E 3-13318 FOR A FLOW DIAGRAM OF THE FEED MAKEUP AREA USING ALL OF THE ABOVE LINES.

- (15)— 2" G. FEED TO HCL HEAD TANK ON 4TH FLOOR.
- (16)— 2" G. VENT TO ALL TANKS (EXCEPT WATER).
- (17)— 1" G. FROM P-1 TO HEAT EXCHANGER & WOODEN PRESS.
- (18)— 1" G. FROM OLIVER FILTER TO IRON FILTER PRESS.
- (19)— 1" G. HCL & WATER TO EIMCO FILTER.
- (20)— 1" G. NH_4OH & WATER TO THE [illegible].
- (21)— 1" G. NH_4OH & WATER TO THE OLIVER FILTER.

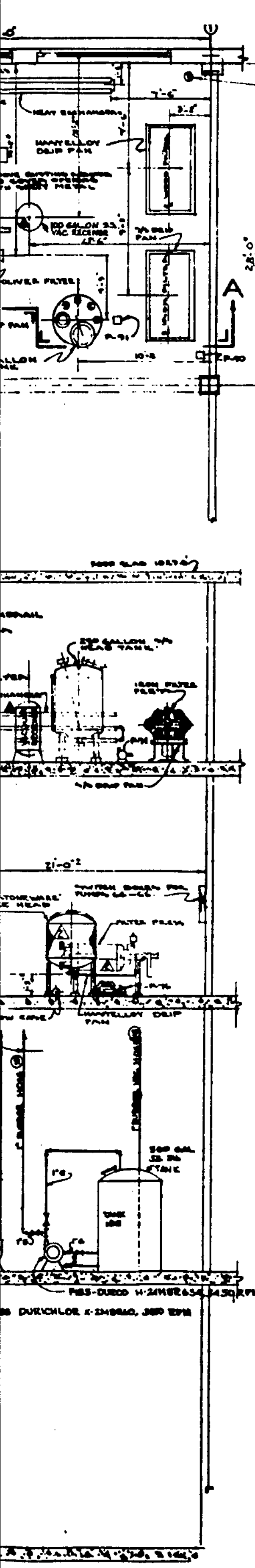
GEN. NOTES

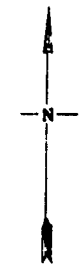
1. ALL GLASS PIPING SHOWN TO BE PYREX GLASS.
2. ALL VALVES ON GLASS LINES TO BE HILLS MCCANNA GLASS LINED VALVES, EXCEPT WHERE NOTED.
3. USE HILLS MCCANNA S/S DIAPHRAGM VALVES ON S/S LINES & BRASS OR STEEL GATE VALVES ON STEEL OR BLACK IRON LINES.
4. PIPING SHOWN DIAGRAMMATICALLY ONLY AND MAY BE VARIED TO MEET FIELD CONDITIONS.
5. PIPE SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
6. GLASS PIPE MAY BE SUBSTITUTED FOR S/S OR STEEL PIPES WHEREVER IT IS MORE EXPEDIENT.
7. PIPING HOOKUP FOR WOOD FILTER PRESSES IS THE SAME AS SHOWN FOR IRON FILTER PRESS.
8. ALL FILTER PRESSES TO BE EQUIPPED WITH DRIP PANS AS NOTED. DRIP PANS TO BE SIZED & CONSTRUCTED IN THE FIELD.
9. FOR EQUIPMENT LOCATION IN THE PURIFICATION & CALCINING AREAS SEE DWG. E 10-13355.
10. DIAGRAMMATICAL PUMP HOOKUP TO APPLY TO ALL MILTON ROY DUPLEX PUMPS.

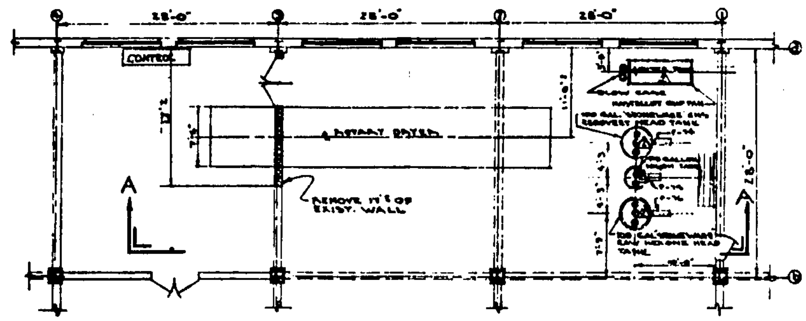
PERMANENT ZIRCONIUM PLANT PIPING LAYOUT-PURIFICATION AREA, PLAN & SECTIONS



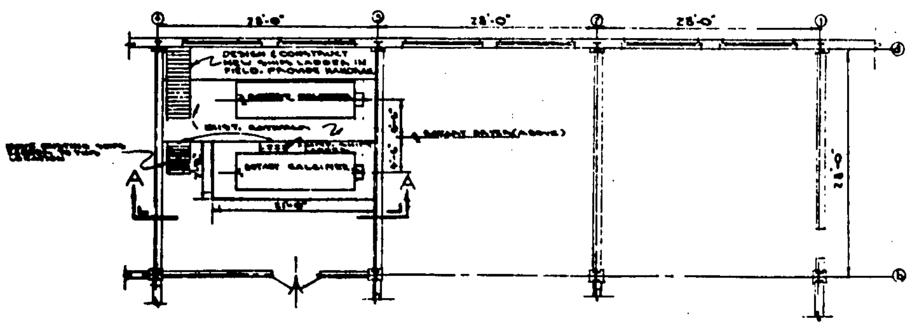
PART PLAN 4th FL.
WOOD FILTER PRESS
250 GALLON NYLON HEAD TANK
STORAGE
CONDENSER
EVAPORATOR
OLIVER FILTER
HEAT EXCHANGER
ROTARY DRYER
DRYER & CALCINER CONTROL PANEL
ROTARY CALCINER
EXISTING REACTORS
EXISTING PLATFORM
POWER PANEL
NEW CHLORINATION AREA
ELEVATION "A-A"



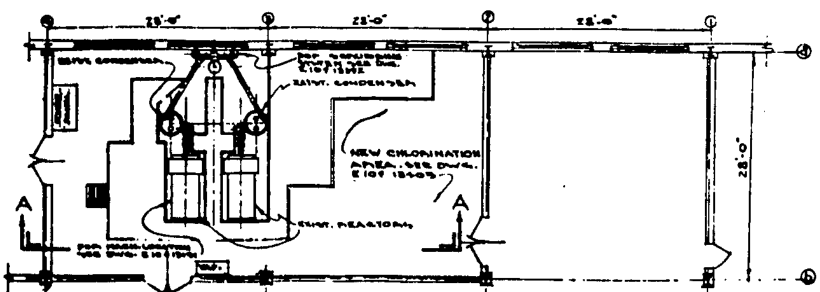




PART PLAN—3RD FL.
SCALE ~ 1/8"=1'-0"



PART PLAN—2ND FL.
SCALE ~ 1/8"=1'-0"



PART PLAN 1ST FL.
SCALE ~ 1/8"=1'-0"

REF. DWGS.

E 24 [illegible] —— PERMANENT ZIRCONIUM PLANT —— EQUIPMENT BASES —— PURIFICATION & EXTRACTION CONTROL AREA.

D 24 15093 —— PERMANENT ZIRCONIUM PLANT —— STRUCTURAL ALTERATIONS —— EXTRACTION CONTROL AREA.

E 104 [illegible] —— PERMANENT ZIRCONIUM PLANT —— PIPING LAYOUT —— PURIFICATION AREA.

E 104 15151 —— PERMANENT ZIRCONIUM PLANT —— REVISED MACHINE LOCATION —— CHLORINATION SYSTEM.

E 104 15392 —— PERMANENT ZIRCONIUM PLANT —— SCRUBBING SYSTEM —— ZIRCONIUM CHLORINATION.

E 104 15403 —— PERMANENT ZIRCONIUM PLANT —— EQUIPMENT LOCATION —— REACTOR AREA.

[illegible] —— ROTARY DRYER —— C.O. BARTLETT & SNOW CO.

[illegible] —— ROTARY CALCINER —— C.O. BARTLETT & SNOW CO.

[illegible] —— EIMCO 4'-0" DIA. DRUM FILTER —— EIMCO CORPORATION.

[illegible] —— OLIVER 3'-0" DIA. DRUM FILTER —— OLIVER UNITED FILTERS.

[illegible] —— SPERRY FILTER PRESS —— D.R. SPERRY AND CO.

D8F-15455 —— CONTROL PANEL

GEN. NOTES

1—ALL EQUIPMENT AND CONSTRUCTION SHOWN ON 2ND, 3RD, & 4TH FLOORS TO BE NEW, EXCEPTION NOTED.

2—ALL EQUIPMENT SHOWN ON 1ST FLOOR IS EXISTING.

3—ALL TANK SUPPORTS TO BE DESIGNED IN THE FIELD.

4—DIMENSIONS SHOWN ARE APPROXIMATE AND MAY BE VARIED TO MEET FIELD CONDITIONS.

5—SEE MANUFACTURERS DRAWINGS FOR DETAILS OF ROTARY DRYER, ROTARY CALCINERS, EIMCO & OLIVER FILTERS & FILTER PRESSES.

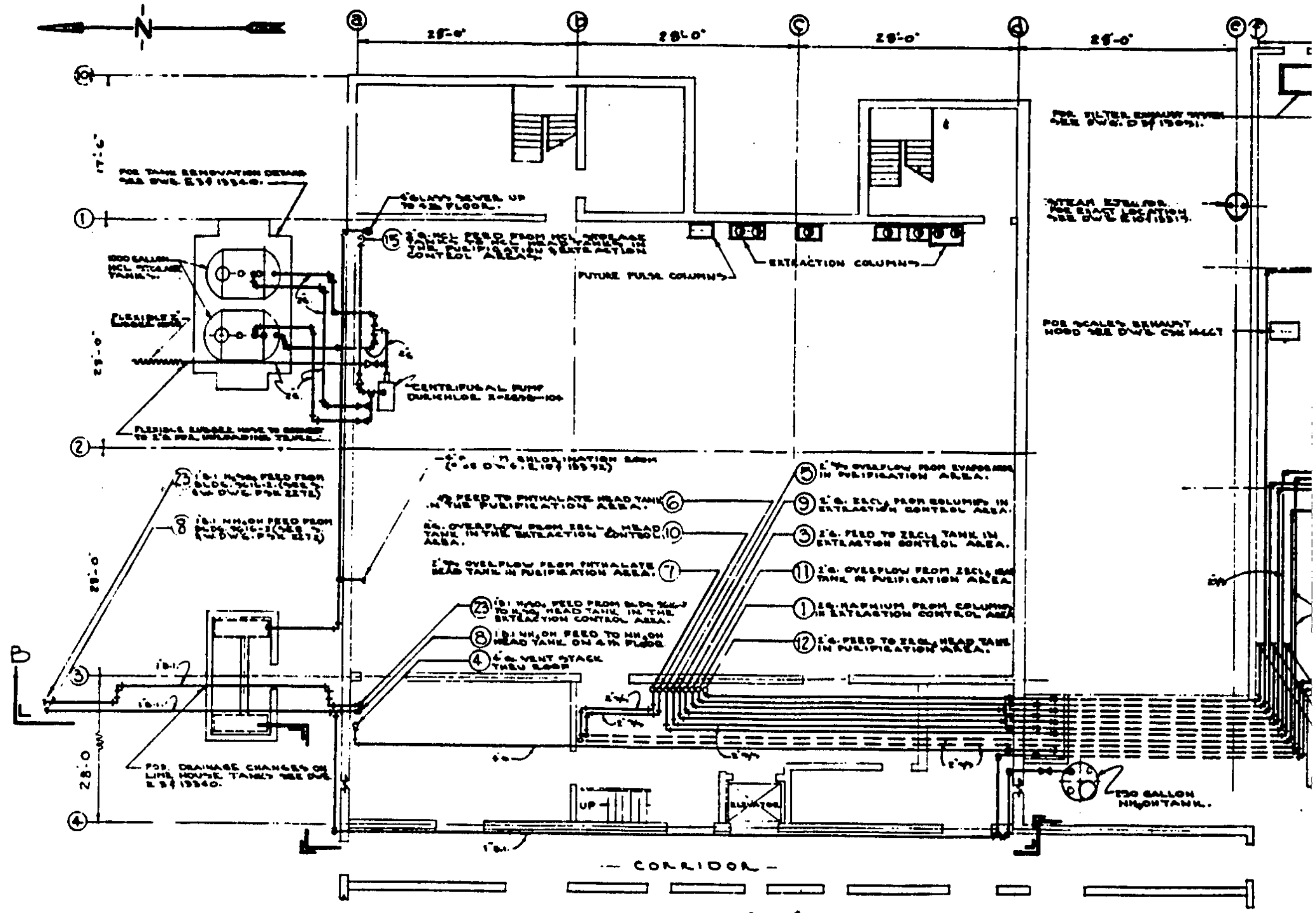
6—PUMPS (INDICATED BY P-[illegible]) TO BE LOCATED APPROX. WHERE SHOWN BUT EXACT LOCATION TO BE DETERMINED IN FIELD.

7—FOR PUMP SCHEDULE SEE DWG. NO. E104 15380.

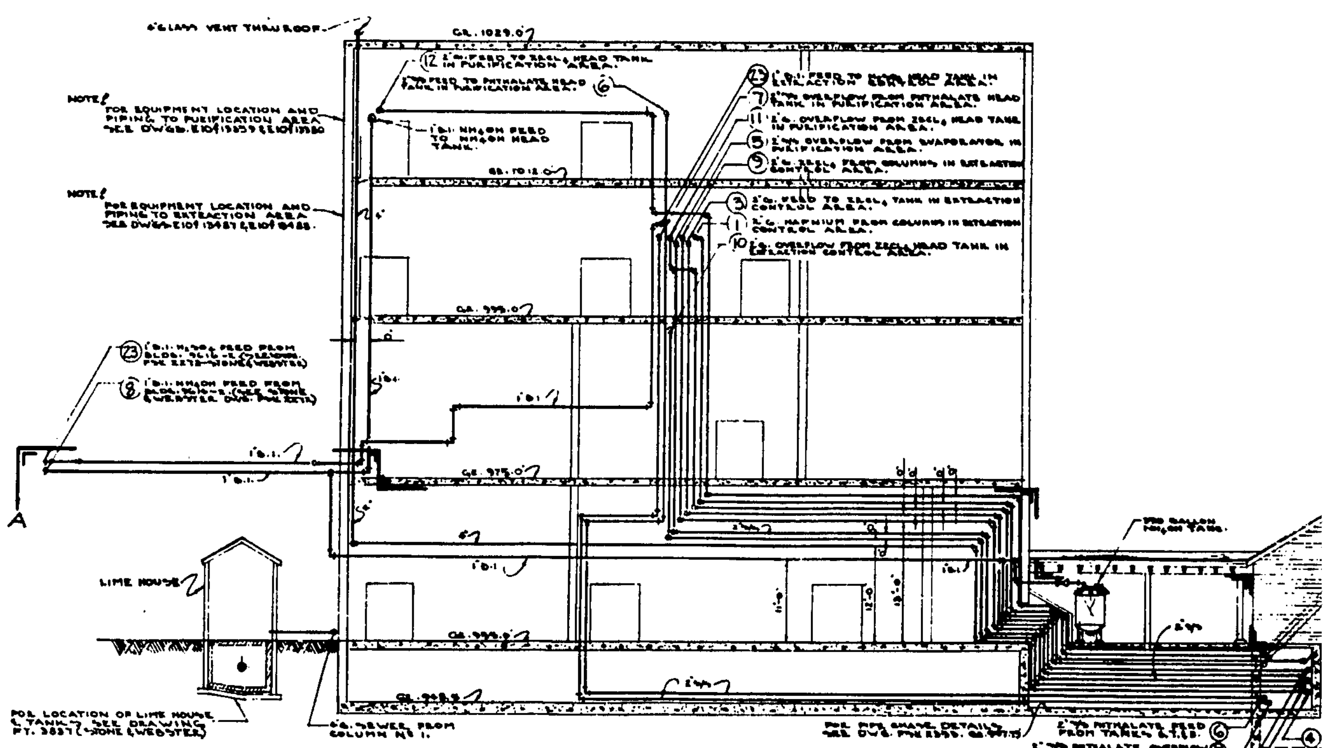
8—ALL FILTER PRESSES TO BE EQUIPPED WITH DRIP PANS AS NOTED. DRIP PANS TO BE SIZED AND CONSTRUCTED IN THE FIELD.

9—ALL TANKS TO BE EQUIPPED WITH SIGHT GLASSES. SIZE OF GLASSES WILL DEPEND ON SIZE OF EXIST. OPENINGS IN TANKS.

2

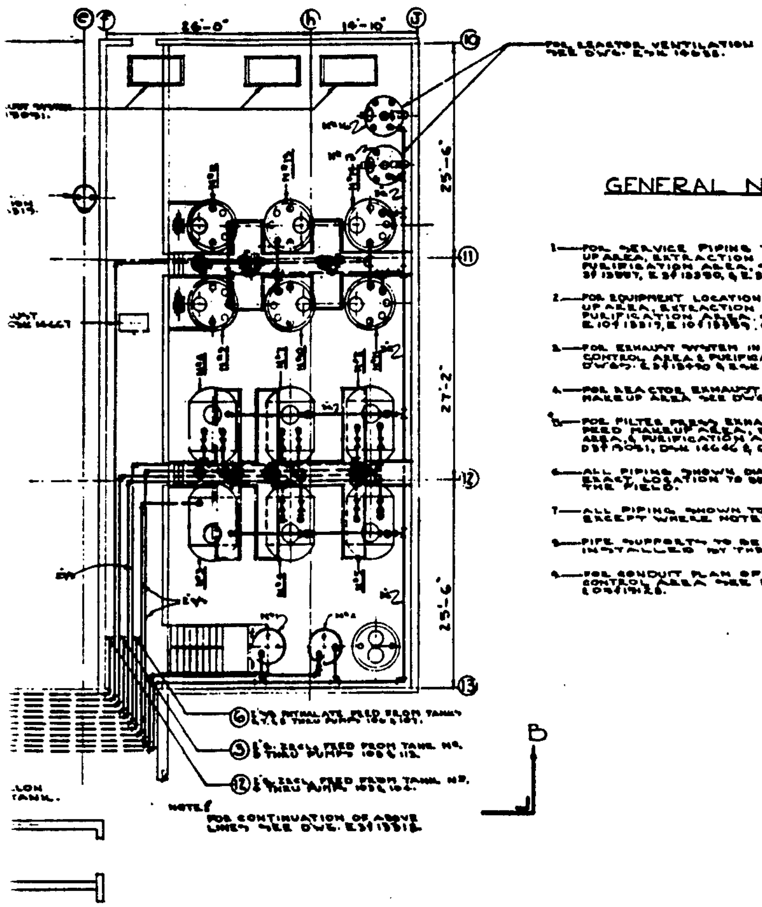


PART PLAN-'A A'



SECTION-'B B'

(COLUMN No. 4 WALLS OMITTED)



GENERAL NOTES

1—FOR SERVICE PIPING TO THE FEED MAKE UP AREA, EXTRACTION CONTROL AREA, & PURIFICATION AREA, SEE DRAWINGS E-37 13557, E 37 13550, & E 37 13554.

2—FOR EQUIPMENT LOCATION TO THE FEED MAKE UP AREA, EXTRACTION CONTROL AREA, & PURIFICATION AREA, SEE DRAWINGS: E 10 13317, E 10 13359, & E 10 13457.

3—FOR EXHAUST SYSTEM IN THE EXTRACTION CONTROL AREA & PURIFICATION AREA SEE DWGS. E 37 13490 & E-SK 14664.

4—FOR REACTOR EXHAUST SYSTEM IN THE FEED MAKEUP AREA SEE DWG. E-SK 14635.

5—FOR FILTER PRESS EXHAUST SYSTEMS IN THE FEED MAKEUP AREA, EXTRACTION CONTROL AREA, & PURIFICATION AREA, SEE DRAWINGS D37 15051, D-SK 14646 & D-SK 14674.

6—ALL PIPING SHOWN DIAGRAMMATICALLY ONLY. EXACT LOCATION TO BE DETERMINED BY THE FIELD.

7—ALL PIPING SHOWN TO BE PYREX GLASS EXCEPT WHERE NOTED.

8—PIPE SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.

9—FOR CONDUIT PLAN OF THE EXTRACTION CONTROL AREA SEE DWGS E-SK 14640 & D-SK 15128.

PIPE MARK SCHEDULE

① — 2" G. HAFNIUM FROM COLUMNS IN EXTRACTION CONTROL AREA TO HAFNIUM TANKS 11 & 14 IN FEED MAKEUP AREA.

③ — 2" G. ZRCL₄ FEED FROM STORAGE TANK NO 3 IN FEED MAKEUP AREA TO ZRCL₄ HEAD TANK IN EXTRACTION CONTROL AREA.

④ — 3" G. VENT FROM ALL TANKS IN THE FEED MAKEUP AREA TO THE NORTH WALL OF BLDG. 9211 & THEN THRU ROOF WITH A 4" STACK.

⑤ — 2" S/S OVERFLOW FROM EVAPORATOR IN PURIFICATION AREA TO PHTHALATE STORAGE TANKS 6, 7, & 8 IN THE FEED MAKE UP AREA.

⑥ — 2" S/S PHTHALATE FEED FROM PHTHALATE TANKS 6, 7, & 8 IN FEED MAKEUP AREA TO PHTHALATE HEAD TANK IN PURIFICATION AREA.

⑦ — 2" S/S OVERFLOW FROM PHTHALATE HEAD TANK IN PURIFICATION AREA TO PHTHALATE STORAGE TANKS 6, 7, & 8 IN THE FEED MAKEUP AREA.

⑧ — 1" B.I. NH₄OH FEED FROM BLDG. 9616-2 TO NH₄OH HEAD TANK IN THE FEED MAKEUP AREA. (SEE S.&W. DWG FSK 2272)

⑨ — 2" G. ZRCL₄ FROM COLUMNS IN EXTRACTION CONTROL AREA TO PRODUCT STORAGE TANKS 4 & 5 IN FEED MAKE UP AREA.

⑩ — 2" G. OVERFLOW FROM ZRCL₄ HEAD TANK IN EXTRACTION CONTROL AREA TO FEED STORAGE TANK NO 3 IN FEED MAKEUP AREA.

⑪ — 2" G. OVERFLOW FROM ZRCL₄ HEAD TANK IN PURIFICATION AREA TO PRODUCT STORAGE TANKS 4 & 5 IN FEED MAKEUP AREA.

⑫ — 2" G. ZRCL₄ FEED FROM PRODUCT STORAGE TANKS 4 & 5 IN FEED MAKEUP AREA TO ZRCL₄ HEAD TANK IN PURIFICATION AREA.

⑮ — 2" G. HCL FEED FROM HCL STORAGE TANKS ON THE NORTH SIDE OF BLDG. 9211 TO HCL HEAD TANKS IN THE PURIFICATION & EXTRACTION CONTROL AREAS.

⑯ — 2" G. VENT TO ALL TANKS (EXCEPT WATER) IN THE PURIFICATION AREA.

㉓ — 1" B.I. H_2SO_4 FEED FROM BLDG 9616-2 TO H_2SO_4 HEAD TANK IN THE EXTRACTION CONTROL AREA. (SEE S.&W DWG FSK 2272)

㉕ 1" & 2" G. VENT TO ALL TANKS (EXCEPT WATER) IN THE EXTRACTION CONTROL AREA.

REF. DWGS.

FSK 2593—TANK FARM STORAGE PLATFORM—STONE & WEBSTER.

FSK 2272 — YARD PIPING — BLDG. 9211 — STONE AND WEBSTER.

F7 3837— —PERMANENT ZIRCONIUM PLANT—PUMP HOUSE AND SAMPLING TANKS.

E-SK 14640—PERMANENT ZIRCONIUM PLANT — CONDUIT PLAN — EXTRACTION CONTROL AREA.

D-SK 14674—PERMANENT ZIRCONIUM PLANT—FILTER PRESS EXHAUST SYSTEM—PURIFICATION AREA.

C-SK 14667—PERMANENT ZIRCONIUM PLANT—SCALES EXHAUST HOOD—FEED MAKEUP AREA.

E-SK 14635—PERMANENT ZIRCONIUM PLANT—REACTOR EXHAUST SYSTEM—FEED MAKEUP AREA.

E-SK 14664—PERMANENT ZIRCONIUM PLANT—FEED EXHAUST SYSTEM—FEED MAKEUP AREA.

D-SK 14646—PERMANENT ZIRCONIUM PLANT—FILTER PRESS EXHAUST SYSTEM—EXTRACTION CONTROL AREA.

D 37 15051—PERMANENT ZIRCONIUM PLANT—FILTER PRESS EXHAUST SYSTEM—FEED MAKEUP AREA.

E 37 13490—PERMANENT ZIRCONIUM PLANT—EXHAUST SYSTEM—PURIFICATION AREA.

E 34 12310—PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM—FEED MAKE UP AREA.

E 10 13317—PERMANENT ZIRCONIUM PLANT—EQUIPMENT LOCATION—FEED MAKEUP AREA.

E 10 13359—PERMANENT ZIRCONIUM PLANT—EQUIPT. LOCATION—PURIFICATION & CALCINING AREAS.

E 10 13380—PERMANENT ZIRCONIUM PLANT PIPING LAYOUT—PURIFICATION AREA.

E 10 13457—PERMANENT ZIRCONIUM PLANT—EQUIPT. LOCATION—EXTRACTION CONTROL AREA.

E 10 13488—PERMANENT ZIRCONIUM PLANT—PIPING LAYOUT—EXTRACTION CONTROL AREA.

E 10 13536—PERMANENT ZIRCONIUM PLANT—FLOW DIAGRAM—EXTRACTION COLUMNS.

E 37 13550—PERMANENT ZIRCONIUM PLANT—SERVICE LINES—EXTRACTION CONTROL AREA.

E 37 13554—PERMANENT ZIRCONIUM PLANT—SERVICE LINES—PURIFICATION AREA.

E 37 13557—PERMANENT ZIRCONIUM PLANT—DEMINERALIZED WATER—FEED MAKEUP AREA.

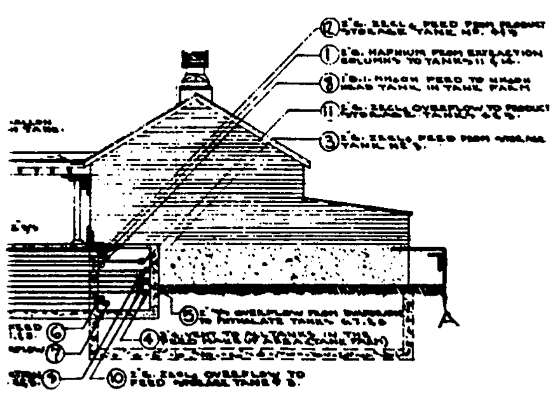
E 24 13360—PERMANENT ZIRCONIUM PLANT—CONTACT TANK RENOVATION—BLDG. 9810-4.

E 10 13534—PERMANENT ZIRCONIUM PLANT—CHLORINATION SCRUBBING SYSTEM.

D 39 15128—PERMANENT ZIRCONIUM PLANT—ONE LINE DIAGRAM—EXTRACTION CONTROL AREA.

TANK SCHEDULE

1, 6, 7 & 8	PHTHALATE STORAGE
2	NH_4OH
3	FEED STORAGE
4 & 5	PRODUCT STORAGE
9, 10, 12 & 13	FEED MAKEUP
11, 14, 15 & 16	HAFNIUM



LEGEND

①—㉕	PIPE NUMBERING (SEE PIPE MARK SCHEDULE)
— — — —	HIDDEN LINES
B.I.	BLACK IRON
S/S	STAINLESS STEEL
S	STEEL
~~	FLEXIBLE RUBBER HOSE
G.	GLASS
●	EXTRACTION COLUMNS

PERMANENT ZIRCONIUM PLANT, GENERAL PIPING LAYOUT

②

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